UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

MAY 22 2000

Robert C. Shinn, Jr.
Commissioner
New Jersey Department
of Environmental Protection
401 East State Street
P.O. Box 402
Trenton, New Jersey 08625-0402

Dear Mr. Shinn:

The U.S. Environmental Protection Agency (EPA) has received and reviewed the New Jersey Department of Environmental Protection's (NJDEP) Total Maximum Daily Loads (TMDLs) for two volatile organics, tetrachloroethene (PCE) and 1,2-dichloroethane (DCE), for the Delaware River Estuary. The Delaware has been listed, under Section 303(d) of the Clean Water Act (CWA), as a high priority for TMDL development for DCE and PCE.

The EPA has completed its review of the TMDLs and has determined that they are consistent with Section 303(d) of the CWA, and implementing regulations under 40 CFR Part 130.7, and are hence, approved. The TMDLs established by the State of New Jersey have been established at levels necessary to implement the applicable water quality standards with seasonal variations, a margin of safety, and take into account critical conditions. The TMDLs include waste load allocations for point sources in the States of New Jersey, Delaware, and Pennsylvania. EPA's approval action of these TMDLs applies to the New Jersey portion of the TMDL which includes waste load allocations for DCE and PCE for point sources in New Jersey. EPA's support document for this approval is enclosed.

The TMDLs for DCE and PCE have been developed through the Delaware River Basin Commission (DRBC) with cooperation from the States of New Jersey, Pennsylvania, Delaware and New York and EPA Regions 2 and 3. On January 26, 2000, the DRBC passed a resolution stating that the assimilative capacity of the tidal Delaware River is exceeded for the two pollutants, DCE and PCE. The DRBC resolution directs the State agencies to require point source dischargers to the Delaware to collect one year of effluent data to measure the magnitude and variability of the pollutants, DCE and PCE. Upon completion of the monitoring program, State agencies will be required to implement the appropriate waste load allocations for point source dischargers.

The TMDLs were completed in accordance with the Memorandum of Agreement (MOA), and subsequent amendments, between NJDEP and EPA for TMDL development. According to the MOA amendment, the TMDLs for DCE and PCE were required to be submitted by February 15, 2000. In accordance with Section 303(d)(2) of the CWA and implementing regulations, 40 CFR Part 130.7(d)(2), NJDEP should take the necessary steps to incorporate the approved TMDLs for DCE and PCE for the Delaware into the appropriate Water Quality Management Plan.

Thank you for your continued efforts and cooperation in establishing TMDLs which will improve the quality of New Jersey's waters.

Sincerely,

Jeanne M. Fox
Regional Administrator

Enclosure

cc: Lance Miller, NJDEP
Tom Fikslin, DRBC
George Golliday, EPA Region 3

REVIEW of DELAWARE RIVER ESTUARY TMDLs

Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R. Part 130 describe the statutory and regulatory requirements of TMDLs. The following information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations. When the information listed below uses the verb "must", this denotes information that is required for EPA to review the elements of the TMDL required by the CWA and regulation.

I. Background Information: Description of Waterbody, Pollutant of Concern and Priority Ranking

A cover memo should describe the waterbody as it is identified on the State's section 303(d) list, the pollutant of concern and the priority ranking of the waterbody. The TMDL submittal must include a description of the point, nonpoint, and natural background sources of the pollutant of concern, including the magnitude and location of the sources, because this information is necessary for EPA to review the load and wasteload allocation which are required by the regulation. The TMDL submittal should also contain a description of any important assumptions, such as: (1) the assumed distribution of land use in the watershed; (2) population characteristics, wildlife resources, other relevant characteristics affecting the characterization of the pollutant of concern and the allocation, as applicable; (3) present and future growth trends, if this is a factor that was taken into consideration in preparing the TMDL; and (4) explanation and analytical basis for expressing the TMDL through surrogate measures, if applicable.

NJ's 1998 Section 303(d) list identifies the Delaware River Estuary (Trenton to the head of Delaware Bay) as impaired due to several pollutants, including 1,2-dichloroethane (DCE) and tetrachloroethene (PCE)(also known as perchloroethylene). The NJDEP's priority ranking for TMDL development for this waterbody is "high." EPA and NJDEP have established a Memorandum of Agreement (MOA) outlining a schedule for TMDL development for 1998 303(d) listed waters. According to the original May 12, 1999 MOA, TMDLs for the Delaware River Estuary volatile organics (i.e., DCE and PCE) were scheduled to be submitted by NJDEP on September 30, 1999. This deadline was subsequently extended by agreement to February 15, 2000. The deadline was extended to allow the Delaware River Basin Commission (DRBC) to respond to comments raised during the public comment period.

The Delaware River Basin Commission (DRBC) is an interstate agency, representing the States of Delaware, New Jersey, Pennsylavania and New York. The DRBC has its own rules and regulations which apply to the Delaware River Estuary. The DRBC rules and regulations contain water quality standards, policies and procedures for establishing wasteload allocations and effluent limitations for point source discharges to the Delaware River. The DRBC, with cooperation from the States of New Jersey, Pennsylvania, Delaware and New York and EPA Regions 2 and 3, undertook, under the auspices of the Delaware River Estuary Program, monitoring, modeling and TMDL efforts to address toxic pollutants. The States, EPA and DRBC agreed to use a phased approach for developing TMDLs for the two volatile organic pollutants, DCE and PCE.

The TMDLs, submitted by the State of New Jersey, which were developed through the DRBC and the Estuary Program, include WLAs for point sources in the States of New Jersey, Delaware and Pennsylvania. The submittal is based upon a resolution, passed by the DRBC on January 26, 2000, stating that the assimilative capacity of the tidal Delaware River is exceeded for the two pollutants, DCE and PCE. The resolution also requires dischargers to collect one year of effluent data to measure the magnitude and variability of these pollutants.

EPA's approval action of these TMDLs applies to the New Jersey portion of the TMDL which includes WLAs for DCE and PCE for point sources in New Jersey. The most significant sources of these pollutants are municipal and industrial point source discharges.

II. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the antidegradation policy, because this information is necessary for EPA to review the load and wasteload allocation which are required by the regulation. A numeric water quality target for the TMDL (a quantitative value used to measure whether or not the applicable water quality standard is attained) must be identified. If the TMDL is based on a target other than a numeric water quality criterion, a description of the process used to derive the target must be included in the submittal.

The applicable water quality criteria have been adopted by the DRBC and are included in DRBC's water quality regulations (Article 3, Section 3.30). The DRBC criteria are adopted, by reference, into New Jersey's surface water quality regulations (N.J.A.C. 7:9B-1.14(d)1)). The criteria have been established for the protection of human health from carcinogenic effects and vary depending upon the designated use of the waterbody.

Zone	Designated Use	Criteria (μg/L)	
		DCE	PCE
2 and 3	Public water supply after reasonable treatment	0.383[1]	0.80[1]
4 and upper 5	maintenance of resident fish; recreation	98.6[2]	8.85[2]
lower 5	maintenance of resident fish; recreation	17.3[3]	1.55[3]

[1]Based on water and fish consumption.
[2]Based on fish ingestion only.
[3]Based on fish ingestion only, at a higher daily fish consumption rate.

III. Ambient Data and Pollutant Sources

Ambient water quality data collected for volatile organics in the early 1990s indicates exceedances of the ambient water quality criterion for DCE. Data collected during 1996-1998 were inconclusive because the detection limits were higher than the water quality criteria. Data collection was again initiated in July 1999 using more sensitive analytical procedures with detection limits below the applicable criterion.

There are 76 municipal and industrial point sources discharging to the Delaware which were suspected of contributing to the exceedances of water quality criteria. Simplified and complex mathematical models were used to predict exceedances of criteria in several Zones of the Estuary. The simplified model, using net advective flow for the Estuary, the harmonic mean flow for tributaries, and average tidal conditions predicted exceedances of the criteria for the two pollutants. The use of the complex water quality modeling and assumptions indicate that the assimilative capacity of the Estuary is predicted to be exceeded. This is shown in Figure 3 for DCE and Figure 16 (of the TMDL submittal) for TCE (refer to the % reduction scenario in each figure).

Based on the above analyses, DRBC determined that the assimilative capacity is exceeded and that, therefore, TMDLs are required.

IV. TMDL Development

A. Model Development/Loading Capacity

As described in EPA guidance, a TMDL describes the loading capacity of water for a particular pollutant. EPA regulations define loading capacity as the greatest amount of loading that a water can receive without violating water quality standards (40 C.F.R. § 130.2(f)). The TMDL submittal must describe the rationale for the analytical method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many circumstances, a ***critical condition*** *must be described and related to physical conditions in the waterbody (40 C.F.R. § 130.7(c)(1)). Supporting documentation for the analysis must also be included, including the basis for assumptions, strengths and weaknesses in the analytical process, results from water quality modeling, etc., so that EPA can properly review the statutory and regulatory required elements of the TMDL.*

The hydrodynamic and water quality models used to determine the TMDLs are described in detail in *Calibration and Validation of the DYNHYD5 Hydrodynamic Model for the Delaware River Estuary (December 1995)* and in the *Calibration and Validation of a Water Quality Model for Volatile Organics and Chronic Toxicity in the Delaware River Estuary (December 1998).* The DYNHYD5 model consists of 94 nodes, incorporates 11 tributaries, the headwaters of the Delaware River, the C&D Canal and a seaward boundary. The water quality model is the EPA model TOXIWASP. This model incorporates the transport and applicable fate processes for the volatile organic chemicals which include: volatilization, oxidation, biodegradation, and hydrolysis. Since volatile organics do not adsorb strongly to sediment, sediment interactions

were not included in the model. Both the water quality and hydrodynamic models were calibrated and verified.

The loadings for point source dischargers used in the modeling analysis are shown in Tables 4, 5 and 8 of the TMDL submittal. All 76 dischargers were evaluated for inclusion in the TMDL. Forty-one dischargers were determined to contribute DCE, while 40 dischargers contribute PCE. DCE and PCE were not detected in tributary ambient water samples. Design flows were used for all point source dischargers' effluent and their effluent concentration was determined according to DRBC regulations. The loadings analysis is described in detail in the report *Wasteload Allocations for Volatile Organics and Toxicity: Phase I TMDLs for Toxic Pollutants in the Delaware River Estuary (December 1998).* Critical conditions used in determining the TMDL include: mean harmonic flow for tributaries and average tidal hydrodynamics. The mean harmonic flow is specified by DRBC regulations as the appropriate design flow for carcinogens. Use of the mean harmonic design flow for carcinogens is consistent with EPA guidance *(Technical Support Document for Water Quality-Based Toxics Control, EPA/505/2-90-001).*

Based upon the modeling analysis, the TMDLs/WLAs/LAs were calculated by zones ,as shown below:

Volatile Organic Chemical	**No. of Point Sources**	**∑ WLAs (kg/day)**		**∑LAs**	**TMDL (kg/day)**
		Zones 2&3	**Zones 4&5**		
DCE	41	10.31	45.09	0	55.40
TCE	40	20.55	30.10	0	50.65

For DCE, 58% reduction from the baseline loading is required for each significant discharger in Zones 2 and 3 and Zones 4 and 5 in order to meet the criterion (refer to Appendix 1, Figure 7 of the TMDL submittal). For PCE, a 45% reduction is required for each significant discharger in Zones 2 and 3 (refer to Appendix 2, Figure 19 of the TMDL submittal) in order to meet the criterion.

1. Wasteload Allocations (WLAs)

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to existing and future point sources. 40 C.F.R. § 130.2(g). If no point sources are present or the TMDL recommends a zero WLA for point sources, the WLA must be listed as zero. The TMDL may recommend a zero WLA if the State determines, after considering all pollutant sources, that only allocating to nonpoint sources will still result in attainment of the applicable water quality standard. In preparing the Wasteload Allocation, it is not necessary that every individual point source have a portion of the allocation of pollutant loading capacity. But it is necessary to allocate the loading capacity among individual point sources as necessary to meet the

water quality standard. The TMDL submittal should also discuss whether a WLA is based on an assumption that loads from a nonpoint source or sources will be reduced. In such cases, the State will need to demonstrate reasonable assurance that the nonpoint source reductions will occur within a reasonable time.

The summed WLAs are shown under Zones 2 & 3 and Zones 4 & 5, based on the difference in applicable criteria in the zones. The individual WLAs are shown in Table 7 of Appendix 1 and Table 10 of Appendix 2 of the TMDL submittal. The WLAs were determined using the Equal Marginal Percent Reduction procedure which is specified in the DRBC regulations. The procedure reduces the contribution from point sources equally until standards are achieved. The individual WLAs are shown in the column labeled "multiple load (kg/day)" of each Table. The TMDL for DCE includes WLAs for 27 point source discharges from New Jersey. For PCE, the TMDL includes WLAs for 29 point source discharges from New Jersey.

The WLAs shown in Tables 7 and 10 of the TMDL submittal may be subject to change as a result of the additional year of effluent data collection required under the DRBC resolution. Final WLAs will be issued by the DRBC and are expected to be consistent with the TMDLs being approved. EPA must be notified of any revised WLAs.

2. Load Allocations (LAs)

EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity allocated to existing and future nonpoint sources and to natural background. 40 C.F.R. § 130.2(h). Load allocations may range from reasonably accurate estimates to gross allotments. 40 C.F.R. § 130.2(g). Where it is possible to separate natural background from nonpoint sources, separate load allocations should be made and described. If there are no nonpoint sources and/or natural background, or the TMDL recommends a zero load allocation, an explanation must be provided. The TMDL may recommend a zero LA if the State determines, after considering all pollutant sources, that only allocating to point sources will still result in attainment of the applicable water quality standard.

The LAs have been established at zero because atmospheric and sediment contributions of these two pollutants are considered negligible. Volatile organics to do adsorb strongly to sediment. Modeling studies indicate that sediment interactions are not an important process affecting the fate of these chemicals. With regard to tributary loadings, neither pollutant has been detected in tributary ambient water samples collected by either the DRBC or the U.S. Geological Survey. These assumptions are further supported by the calibration and validation of a water quality model using these input values into the model *(Calibration and Validation of a Water Quality Model for Volatile Organics and Chronic Toxicity in the Delaware River Estuary (December 1998))*. The WLAs shown in the table above will result in meeting the applicable water quality standards.

3. Margin of Safety (MOS)

The statute and regulations require that a TMDL include a margin of safety to account for any lack of knowledge concerning the relationship between effluent limitations and water quality. CWA 303(d)(1)(C), 40 C.F.R. § 130.7(c)(1). EPA guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set-aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set-aside for the MOS must be identified.

The margin of safety is incorporated into the conservative assumptions used to develop the TMDL. These assumptions include the use of mean harmonic tributary flow, design effluent flows for point sources, the use of technology-based standards for discharges where effluent data is not of sufficient quantity and quality, and the use of technology-based effluent limitations for industrial discharges.

4. Seasonal Variation

The statute and regulations require that a TMDL be established with seasonal variations. The method chosen for including seasonal variations in the TMDL must be described. CWA 303(d)(1)(C), 40 C.F.R. § 130.7(c)(1).

The criteria used to develop the TMDLs are human health criteria for carcinogens which are designed to protect against long-term human health effects. EPA policy and guidance is that the duration for human health criteria for carcinogens is based on a lifetime exposure of 70 years. For developing TMDLs based on human health criteria for carcinogens, the EPA recommends the use of a long-term harmonic mean flow as the design flow *(Technical Support Document for Water Quality-Based Toxics Control, EPA/505/2-90-001)*. Consistent with these recommendations, the DRBC used the mean harmonic flow for the Delaware and average tidal conditions.

Therefore, for these pollutants, seasonal variation is not an issue because their impact on human health is based on a lifetime exposure.

V. Monitoring Plan for TMDLs Developed Under the Phased Approach

*EPA's 1991 document, **Guidance for Water Quality-Based Decisions: The TMDL Process** (EPA 440/4-91-001), calls for a monitoring plan when a TMDL is developed under the phased approach. The guidance provides that a TMDL developed under the phased approach also needs to provide assurances that nonpoint source control measures will achieve expected load reductions. The phased approach is appropriate when a TMDL involves both point and nonpoint sources and the point source WLA is based on a LA for which nonpoint source controls need to be implemented. Therefore, EPA's guidance provides that a TMDL developed under the phased approach should include a monitoring plan that describes the additional data to be collected to*

determine if the load reductions required by the TMDL lead to attainment of water quality standards.

As part of DRBC's ongoing monitoring program, samples for volatile organics will be collected at 12 river reaches that are the subject of these TMDLs. The sampling effort was initiated in July 1999 and includes 3 collections during the months of July, August and September and monthly collections for other months. Sampling will also be conducted at the head of tide of the major tributaries that are included in the model. Data collected from these monitoring efforts will be used to confirm the boundary loadings used in the model and for reallocations, as necessary.

New Jersey point source dischargers have been monitoring for DCE and PCE and these effluent data will be used as a basis for revising WLAs, as necessary.

VI. Implementation Plan

On August 8, 1997, Bob Perciasepe, EPA Assistant Administrator for the Office of Water, issued a memorandum, "New Policies for Establishing and Implementing Total Maximum Daily Loads (TMDLs)," that directs Regions to work in partnership with States to achieve nonpoint source load allocations established for 303(d)-listed waters impaired solely or primarily by nonpoint sources. To this end, the memorandum asks that Regions assist States in developing implementation plans that include reasonable assurances that the nonpoint source load allocations established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved; a public participation process; and recognition of other relevant watershed management processes. Although implementation plans are not approved by EPA, they help establish the basis for EPA's approval of TMDLs.

Section 4.30.7B.2.c.6 of DRBC's regulations require that WLAs developed by the Commission shall require a permit modification for the point sources discharging to the Delaware. As described above, point sources will continue to monitor their effluent quality for the determination of final WLAs to be incorporated into permits. Upon completion of the monitoring program, DRBC will issue final waste load allocations. These final waste load allocations are expected to be consistent with the TMDLs being approved. However, should the new data indicate the need to revise the TMDLs, the TMDLs must be submitted to EPA for review and approval. When the DRBC issues final waste load allocations, around Fall 2001, the NJDEP will modify permits to reflect the final waste load allocations. EPA must be notified of any revised WLAs.

VII. Reasonable Assurances

EPA guidance calls for reasonable assurances when TMDLs are developed for waters impaired by both point and nonpoint sources and for waters impaired solely by nonpoint sources. In a water impaired by both point and nonpoint sources, where a point source is given a less stringent wasteload allocation based on an assumption that nonpoint source load reductions will occur, reasonable assurance must be explained in order for the TMDL to be approvable, because this information is necessary for EPA to review the load and wasteload allocation which

are required by the regulation.

In a water impaired solely by nonpoint sources, however, reasonable assurances are not required in order for a TMDL to be approvable. For such nonpoint source-only waters, States are encouraged to provide reasonable assurances regarding achievement of load allocations in the implementation plans described in Section VI, above. As described in the August 8, 1997 Perciasepe memorandum, such reasonable assurances should be included in State implementation plans and "may be non-regulatory, regulatory, or incentive-based, consistent with applicable laws and programs."

The TMDLs rely on the implementation of WLAs for industrial and municipal point source discharges through the development of permit limits. Because there are no significant nonpoint sources of DCE and PCE, the load allocations have been set to zero. It is anticipated that upon implementation of the WLAs, the Delaware River Estuary will achieve standards for DCE and PCE. The DRBC conducts routine surveys of Zones 2 through 6 of the Delaware River. These data, in addition to effluent data required through the point source permitting program, will provide the DRBC with data to determine if standards are being achieved. DRBC regulations require that the WLAs be reviewed and, if required, revised every five years, or as directed by the DRBC.

VIII. Public Participation

EPA policy is that there must be full and meaningful public participation in the TMDL development process. Each State must therefore provide for public participation consistent with its own public participation requirements. In guidance, EPA has explained that final TMDLs submitted to EPA for review and approval must describe the State's public participation process, including a summary of significant comments and the State's responses to those comments. When EPA establishes a TMDL, EPA regulations require EPA shall publish a notice seeking public comment. 40 C.F.R. § 130.7(d)(2).

Inadequate public participation is not a basis for disapproving a TMDL; however, where EPA determines that a State has not provided adequate public participation, EPA may defer its approval action until adequate public participation has occurred, either by the State or by EPA.

The DRBC began the public notice period on February 9, 1999. In addition, public hearings were held on May 3, 1999 in Wilmington, DE, on May 5, 1999 in West Trenton, NJ and on May 11, 1999 in Philadelphia, PA. The public comment period was extended an additional 30 days to June 11, 1999. DRBC received comments from 23 individuals and organizations including government agencies, environmental/resource organizations, industries, municipalities and county agencies with discharges to the Estuary, as well as a coalition of 23 industrial and municipal dischargers to the Estuary. DRBC prepared two documents summarizing the comments received and DRBC's response to the comments (documents dated December 1999 and January 2000). EPA has reviewed the summary of public comments and responses and has determined that the DRBC adequately responded to all comments.

IX. Submittal Letter

A submittal letter should be included with the TMDL analytical document, and should specify whether the TMDL is being submitted for a technical review or is a final submittal. Each final TMDL submitted to EPA must be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under § 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State's intent to submit, and EPA's duty to review, the TMDL under the statute.

NJDEP provided a cover letter dated February 16, 1999 indicating that the TMDLs were being submitted for EPA review and approval.

State of New Jersey
Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

February 16, 2000

Ms. Jeanne M. Fox
Regional Administrator
U.S. Environmental Protection Agency—Region II
290 Broadway
New York, New York 10007-1866

RE: Report on Total Maximum Daily Load for the Delaware Estuary Volatile Organics, and Amendments to the Tri-County and Lower Delaware Water Quality Management Plans

Dear Administrator Fox:

On behalf of the New Jersey Department of Environmental Protection (Department), the Division of Watershed Management is pleased to submit to your office for review and approval the attached report establishing a total maximum daily load (TMDL) for volatile organics in the Delaware Estuary as prepared by the Delaware River Basin Commission (DRBC) which will be incorporated into both the Tri-County and Lower Delaware Water Quality Management Plans

According to the May 10, 1999 MOA between your agency and this Department, this TMDL was originally scheduled to be submitted on September 30, 1999. The agreed upon revised date is February 15, 2000. In exchange for the revised date, the Department has agreed to move up the TMDL for Strawbridge Lake, Burlington County to August 15, 2000 (originally December 31, 2000).

We look forward to receiving your final decision on this Departmental action. If you have any questions or require further information, please contact me at 609-984-0058, Barbara Hirst, Bureau Chief, Lower Delaware Bureau, at 609-633-1441 or Dr. Thomas Fikslin at DRBC, 609-883-9500, ext. 253.

Sincerely,

Lance Miller
Director

c: Kevin Brick, USEPA Region II (w/o enclosures)
Felix Locicero, USEPA Region II (w/enclosures)
Rosella O'Conner, USEPA Region II (w/o enclosures)

Enclosures:

DEP:
1) DRBC Resolution 2000-4

DRBC:
1) Transmittal letter from DRBC Executive Director Carol R. Collier dated 2/14/2000.
2) Numerical Values for the Assimilative Capacity for 1,2-Dichloroethane and Tetrachloroethene in the Tidal Delaware River (Pursuant to Resolution 2000-4) 1-7p. [Note: no pages 7-14]
3) Appendix 1: 1,2 -Dichloroethane Section of "Wasteload Allocations for Volatile Organics and Toxicity: Phase I TMDLs for Toxic Pollutants in the Delaware River Estuary: Dec. 1998. Pg. 15-31.
4) Appendix 2:Tetrachloroethene Section of "Wasteload Allocations for Volatile Organics and Toxicity: Phase I TMDLs for Toxic Pollutants in the Delaware River Estuary" Dec. 1998. Pg. 31-46.

DEP APPENDIX 1:

DRBC RESOLUTION 2000-4

4pg.

A RESOLUTION relating to the control of toxic pollutants from point sources discharging to the Delaware River Estuary ("the Estuary"), determining that allocations of the waste assimilative capacity of the Estuary are necessary for certain pollutants to maintain stream quality objectives, and directing further staff actions.

WHEREAS, the Delaware River Basin Commission ("the Commission") has set forth in Articles 3 and 4 of the Delaware River Basin Commission, Administrative Manual - Part III, Water Quality Regulations ("the Water Quality Regulations") standards and regulations to protect the quality of the waters of the Delaware River Basin; and

WHEREAS, the Commission has adopted additional regulations to sustain minimum streamflows to the Estuary to support instream uses, including public water supply, recreation and aquatic life; and

WHEREAS, the Commission, following public hearings, in Resolution No. 96-12 ("the Resolution") amended its Comprehensive Plan and Water Code and adopted regulations relating to the control of toxic pollutants from point sources discharging to the Estuary; and

WHEREAS, the Resolution sets forth in Tables 5 and 6 stream quality objectives for toxic pollutants and carcinogens to protect human health and aquatic life; and

WHEREAS, Article 4 of the Water Quality Regulations authorizes the Commission to determine that allocations of a stream's waste assimilative capacity are necessary to maintain stream quality objectives or protect water uses in a given zone; and

WHEREAS, Article 4 of the Water Quality Regulations specifies the design conditions for tributary flow and loading and for effluent flow and loading that shall be used in establishing wasteload allocations; and

WHEREAS, Commission staff were directed to conduct public hearings on whether the assimilative capacity of the Estuary is being exceeded for 1,2- dichloroethane, tetrachloroethene, chronic toxicity and acute toxicity ("the pollutants"); and

WHEREAS, public hearings on a proposed determination by the Commission that the assimilative capacity of the Estuary is being exceeded for these pollutants were held on May 3, 1999 in Wilmington, Delaware, on May 5, 1999 in West Trenton, New Jersey and on May 11, 1999 in Philadelphia, Pennsylvania; and

WHEREAS, the public record on the proposed determination remained open for 30 days from the final hearing date to receive comments, and oral and written comments were received from 23 individuals and organizations, including governmental organizations; environmental/ resource organizations; and industries, municipalities and county agencies with discharges to the Estuary, as well as from a coalition of 23 industrial and municipal dischargers to the Estuary; and

WHEREAS, these activities follow a ten-year effort that commenced in 1989 when the Commission initiated the Estuary Toxics Management Program; and

WHEREAS, the staff of the Commission, in a public hearing Response Document relating to the proposed determination, has recommended that the Commission take certain actions; and

WHEREAS, the Commission's Toxics Advisory Committee in a meeting on Monday, December 6, 1999 also made a series of findings and recommendations concerning the control of toxic pollutants from point sources discharging to the Estuary; and

WHEREAS, the Toxics Advisory Committee has concluded, based upon simple mass balances and complex mathematical modeling, that the assimilative capacity of the tidal Delaware River has been exceeded for 1,2- dichloroethane ("DCE") and tetrachloroethene ("PCE"), in Zones 2 and 3 under design conditions; and

WHEREAS, the Toxics Advisory Committee also has recommended that controls be implemented on acute and chronic toxicity for individual point sources and has made certain further findings and recommendations; and

WHEREAS, the Commission has reviewed the public record on this matter, including the recommendations of the Commission staff and the Toxics Advisory Committee; and

WHEREAS, in order to protect public health and aquatic life, the Commission seeks to ensure that its stream quality objectives for the Estuary are met and maintained, now therefore

BE IT RESOLVED by the Delaware River Basin Commission:

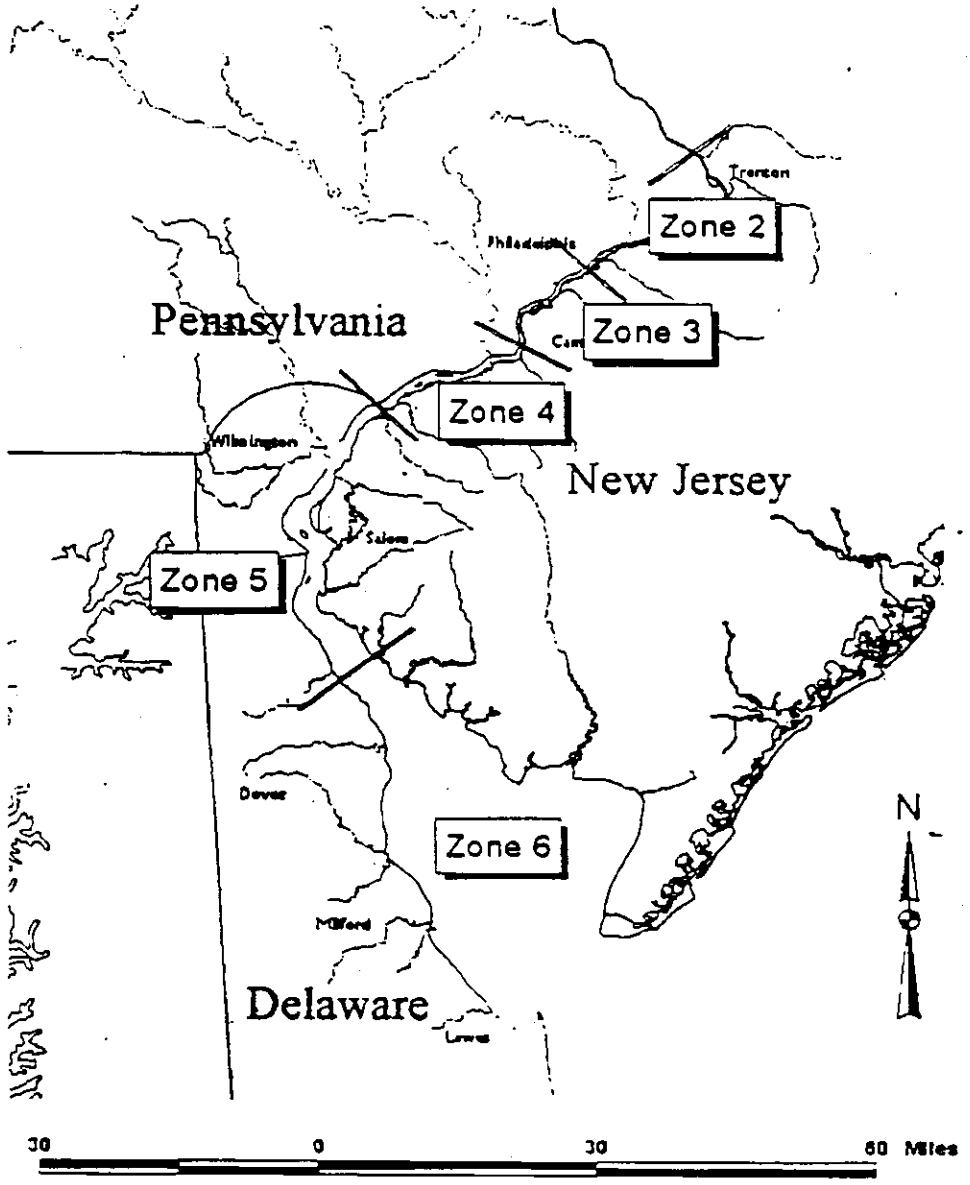
1. The Commission hereby determines that allocations of the waste assimilative capacity of the Delaware River Estuary are necessary to maintain stream quality objectives in Zones 2 and 3 for the following pollutants:

   a. 1,2 - dichloroethane
   b. tetrachloroethene

2. The Commission directs the Executive Director and staff of the Commission to establish a numerical value for the assimilative capacity for 1,2 - dichloroethane and tetrachloroethene in Zones 2 and 3, considering the loading of these two pollutants in Zones 4 and 5, for use by the signatory parties in establishing Total Maximum Daily Loads ("TMDLs") as appropriate under the federal Clean Water Act, 33 U.S.C. § 1251 et seq.

3. The Executive Director shall require dischargers of the aforementioned pollutants to collect one year of effluent data to measure the magnitude and variability of these pollutants. The Commission directs the Executive Director and staff of the Commission to work cooperatively with the Commission's Toxics Advisory Committee to develop effluent sampling and analytical requirements. The Executive Director shall establish wasteload allocations or other effluent requirements, including monitoring, that may be necessary to meet stream quality objectives, taking into consideration the most recent data on effluent and tributary loadings. The

ESTUARY ZONES



wasteload allocations shall be referred to the regulatory agencies of the signatory parties for use as appropriate in developing effluent limitations, schedules of compliance, and other permit requirements in accordance with Section 4.30.7B.2.c.(6) of the Commission's Water Quality Regulations.

4. The Commission hereby determines that allocations of the waste assimilative capacity of the Delaware River Estuary are necessary for certain individual discharges to maintain stream quality objectives in Zones 2, 3, 4 and 5 for the following pollutants:

   a. acute toxicity
   b. chronic toxicity

5. The Executive Director shall establish wasteload allocations or other effluent requirements for acute and chronic toxicity for individual discharges that exceed stream quality objectives. The wasteload allocations shall be referred to the regulatory agencies of the signatory parties for use as appropriate in developing effluent limitations, schedules of compliance, and other permit requirements in accordance with Section 4.30.7B.2.c.(6) of the Commission's Water Quality Regulations.

6. The Commission directs the Executive Director and staff of the Commission to continue to work cooperatively with the Commission's Toxics Advisory Committee to study and characterize the nature and extent of toxicants contributing to chronic toxicity in the Delaware River Estuary, and to recommend to the Commission such further controls as may be necessary to address chronic toxicity in the Estuary resulting from the cumulative discharge from all sources.

7. This resolution shall take effect immediately.

/s/ Warren T. Lavery
Warren T. Lavery, Chairman pro tem

/s/ Pamela M. Bush
Pamela M. Bush, Secretary

ADOPTED: January 26, 2000

Delaware River Basin Commission
DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

Delaware River Basin Commission
PO Box 7360
25 State Police Drive
West Trenton, New Jersey
08628-0360
Phone: (609) 883-9500 Fax: (609) 883-9522
Web Site: http://www.state.nj.us/drbc

Carol R. Collier
Executive Director

Jeffrey P. Featherstone
Deputy Executive Director

February 14, 2000

Mr. Robert C. Shinn, Jr., Commissioner
New Jersey Department of Environmental Protection
401 East State Street
P.O. Box CN-029
Trenton, New Jersey 08625

Dear Commissioner Shinn:

The Commission at its January 26, 2000 meeting unanimously approved Resolution 2000-4 relating to the control of toxic pollutants from point sources discharging to the Delaware River Estuary and determining that allocations of the waste assimilative capacity of the estuary are necessary for certain pollutants to maintain stream quality objectives. The resolution directed the Executive Director and staff of the Commission to establish a numerical value for the assimilative capacity of the estuary for two pollutants, 1,2 - dichloroethane and tetrachloroethene (PCE), for use by the signatory parties in establishing Total Maximum Daily Loads (TMDLs) as appropriate under the federal Clean Water Act.

In order to assist the New Jersey Department of Environmental Protection and the U.S. Environmental Protection Agency, Region II in their action to establish TMDLs for DCE and PCE for the estuary, I am enclosing a document containing the numerical values for the assimilative capacity of Zones 2 and 3 of the Delaware River Estuary for these two pollutants, and the maximum loading of these two pollutants to Zones 4 and 5 that will maintain stream quality objectives in the estuary. The attached also addresses specific requirements of U.S. EPA guidance with respect to the approval of TMDLs submitted by states.

If you have any questions regarding the enclosed document, please contact Dr. Thomas Fikslin of my staff at extension 253.

Sincerely,

Carol R. Collier

Carol R. Collier
Executive Director

Enclosure
c: Commissioners

Numerical Values for the Assimilative Capacity for 1,2 - Dichloroethane and Tetrachloroethene in the Tidal Delaware River

(Pursuant to Resolution 2000-4)

❑ Description of impairment, §303(d) listing, pollutants of concern and priority ranking:

In 1989, the Delaware River Basin Commission created the Estuary Toxics Management Program to address the impact of toxic pollutants in the tidal Delaware River (also called the Delaware Estuary, Figure 1). The mission of this program was to develop policies and procedures to control the discharge of substances toxic to humans and aquatic biota from point sources discharging to this water body. In 1993, Commission staff identified several classes of pollutants and specific chemicals that were likely to exceed water quality criteria currently being developed under the program. These included volatile organics, metals, polychlorinated biphenyls (PCBs), chlorinated pesticides, chronic toxicity and acute toxicity. This list was subsequently included in the Delaware Estuary Programs's Comprehensive Conservation and Management Plan in 1996.

The New Jersey Department of Environmental Protection subsequently included Zones 2 through 5 of the Delaware River for volatile organics in a report entitled "1998 Identification and Setting of Priorities for Section 303(d) Water Quality Limited Waters in New Jersey", September 15, 1998. By Memorandum of Agreement between U.S. Environmental Protection Agency, Region II and the New Jersey Department of Environmental Protection dated May 12, 1999, the NJDEP agreed to develop, public notice, respond to comments and submit to EPA, Total Maximum Daily Loads (TMDLs) for volatile organics in the Delaware Estuary. These TMDLs were the second highest priority of the NJDEP.

The Delaware River Basin Commission unanimously passed a resolution at their meeting on January 26, 2000 stating that allocations of the assimilative capacity of the tidal Delaware River are necessary for two volatile organics, 1,2 - dichloroethane (DCE) and tetrachloroethene (PCE). In addition, the Commission directed the Executive Director and staff of the Commission to establish a numerical value for the assimilative capacity for these two pollutants in Zones 2 and 3 of the Delaware River, considering the loading in Zones 4 and 5, for use by the signatory parties including the New Jersey Department of Environmental Protection in establishing TMDLs.

❑ Description of the applicable water quality standards and identification of numeric target for the TMDLs:

Water quality criteria for these two chemicals were adopted on October 23, 1996 by the Commission and are included in Section 3.30 of Article 3 of the Commission's water quality regulations. The criteria do, however, differ between the zones of the estuary depending on the designated uses of the zone. In Zones 2 and 3, use of the water for public water supply after reasonable treatment is a designated use. In these zones, the water quality standards for protection of human health from carcinogenic effects (referred to as stream quality objectives in the Commission's regulations) are 0.383 μg/l and 0.80 μg/l for DCE and PCE, respectively. In Zone

ESTUARY ZONES

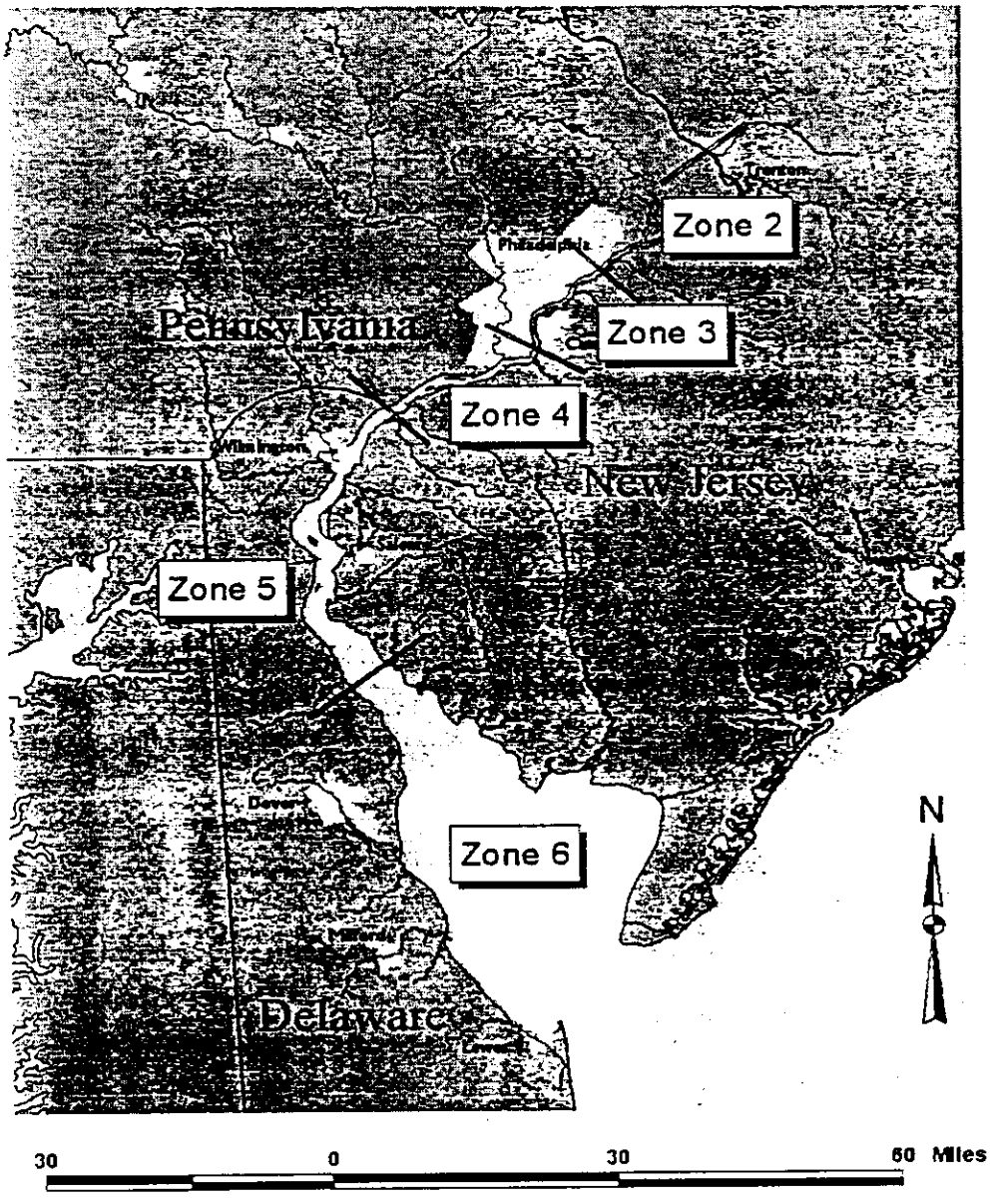


Figure 1: Water Quality Zones of the Delaware River.

4 and upper Zone 5 (above River Mile 68.75), use of the water for public water supply is not a designated use, and the water quality standards for protection of human health from carcinogenic effects are 98.6 μg/l and 8.85 μg/l, respectively. In lower Zone 5, use of the water for public water supply is also not a designated use, and the water quality standards for protection of human health from carcinogenic effects are 17.3 μg/l and 1.55 μg/l, respectively. The differences in the standards in Zones 4 and 5 are related to the higher daily fish consumption rate used in calculating the standard for lower Zone 5.

- **Description of the pollutant sources, loadings and ambient data used as the basis for listing:**

Three approaches were used to determine whether the assimilative capacity of the estuary is being exceeded for DCE and PCE. The first approach involves the use of ambient monitoring data. The second approach involves the use of simple mathematical formulas such as multiplying the water quality criteria times the design flow of the receiving water. The third approach involves the use of more complex mathematical models. Ambient data for volatile organics does indicate concentrations of DCE an order of magnitude higher than the water quality criterion (0.383 μg/l) in the early 1990s. Maximum concentrations observed were 4.1 μg/l at the Navy Yard (RM 93.2), 3.2 μg/l at Wharton Street (RM 98.5), 2.5 μg/l at the Ben Franklin Bridge (RM 100.2), and 1.3 μg/l at the Betsy Ross Bridge (RM 104.7). Data collection in the mid-1990s did not indicate any detections of DCE or PCE when the detection limit used for the sample analyses was higher. Sampling for volatile organics was not performed from 1996 through 1998 due to other monitoring priorities and the use of mathematical models to determine exceedances of water quality criteria. As discussed in the monitoring plan section, sampling for volatile organics was initiated in July 1999 using more sensitive analytical procedures with detection limits below the water quality criteria.

A simplified mathematical approach was also utilized to evaluate whether water quality criteria for DCE and PCE are being exceeded at the design conditions appropriate for human health criteria for carcinogens (i.e., the harmonic mean flow). A net advective flow was determined using the hydrodynamic model for the estuary assuming the harmonic mean flow of all tributaries and average tidal conditions. This approach also assumes that no fate processes are operative. This net advective flow was then multiplied by the applicable water quality criterion to obtain the assimilative capacity for each zone of the river. This capacity was then compared to the loadings from all point sources included in the wasteload allocation for each chemical. Figure 1 indicates the loading of DCE to each of the zones of the estuary. Figure 2 indicates the loading of PCE to each of the zones of the estuary. Note the exceedances of the assimilative capacity in Zones 3, and the potential for loadings in Zone 4 to contribute to exceedances of the assimilative capacity in Zone 3.

More complex mathematical models that are described in the following section confirm the results of the simplified approach. Furthermore, these models confirmed that loadings of volatile organics in Zones 4 and 5 not only influence ambient water concentrations in Zone 3, but also determine the allowable loadings from each of the discharges in these two zones.

❑ **Description of the water quality model, including the loadings capacity analysis and identification of critical conditions:**

The mathematical model used to determine that the assimilative capacity of the estuary is being exceeded, and to develop the TMDLs and WLAs consists of two components: a hydrodynamic model and a water quality model specific to each pollutant. The hydrodynamic model is described in the report entitled "Calibration and Validation of the DYNHYD5 Hydrodynamic Model for the Delaware River Estuary", December 1995. The water quality models for DCE and PCE are described in the report entitled "Calibration and Validation of a Water Quality Model for Volatile Organics and Chronic Toxicity in the Delaware River Estuary", December 1998.

In accordance with DRBC regulations, each of the 76 discharges to the estuary is evaluated for inclusion in the wasteload allocation for a specific pollutant if there is an existing permit limit for the pollutant, effluent data indicated the presence of the pollutant, or there is a reasonable potential for the pollutant to exist in the discharge. 41 discharges were included in the allocation of the assimilative capacity for DCE to wasteloads, while 40 discharges were included in the allocation of the assimilative for PCE. The loading assigned to each of these discharges is discussed in the following section. Loadings from the tributaries were based upon the lower of actual monitoring data or the water quality criterion. Failure to detect either of these compounds in monitoring data collected by the Commission or the U.S. Geological Survey resulted in the boundary concentrations being set to zero. Sediment contributions of these two organic chemicals were considered minimal.

The loadings analysis is described in the report entitled "Wasteload Allocations for Volatile Organics and Toxicity: Phase I TMDLs for Toxic Pollutants in the Delaware River Estuary", December 1998. Loadings were assigned to each of the discharges based upon criteria contained in DRBC regulations and discussed on page 13 of the report. In general, monitoring data reported in Discharge Monitoring Reports (DMRs) submitted by NPDES permittees were the source of effluent quality data. Tables 4 and 5 of the report present the available data and assigned loading for each of the industrial discharges and municipal discharges included in the WLA for DCE. Table 8 of the report contains the available data and assigned loading for each of the industrial discharges and municipal discharges included in the WLA for PCE. Figure 3 indicates the predicted ambient concentration relative to the water quality criteria when these initial loadings are utilized.

Critical conditions for determining the WLAs and TMDLs include the design tributary flows, design effluent flows, and tidal hydrodynamics. The design tributary flows are specified in DRBC regulations as the harmonic mean flow. The actual flow values used in the mathematical model were calculated from data for the years 1970 to 1995, and are listed in Table 3 of the WLA/TMDL report. Design effluent flows were developed according to DRBC regulations, and are listed in Table 2 of the WLA/TMDL report. Average tidal hydrodynamics were use in developing the WLAs and TMDLs.

❑ TMDLs/WLAs/LAs for the Delaware River Estuary

The TMDLs for 1,2 - dichloroethane and tetrachloroethene can be described as follows:

$$TMDL = WLAs + LAs + MOS$$

The load allocations or LAs include loadings to the estuary from 11 tributaries. Since neither chemical was detected in monitoring data collected for the Commission or by the U.S. Geological Survey, the loadings at the tributaries were set to zero. The calibration and validation of a water quality model using these values provides further support for such loading assignment. Atmospheric and sediment contributions of these two chemicals were considered negligible. Neither chemical has been detected in sediment samples collected from the estuary by the U.S. Army Corps of Engineers, and no other non-point sources of these pollutants have been identified.

WLAs were determined using the Equal Marginal Percent Reduction procedure as specified in the Commission's regulations, and the calibrated and validated water quality model for the respective chemical. The WLAs were then summed to determine the TMDL for each chemical.

Volatile Organic Chemical	No. of Point Sources	∑ WLAs (KG/day)		∑ LAs	Margin of Safety	TMDL (KG/day)
		Zones 2&3	Zones 4&5			
1,2 - Dichloroethane	41	10.31	45.09	0.0	Note 1	55.40
Tetrachloroethene	40	20.55	30.10	0.0	Note 1	50.65

Note 1: The margin of safety is incorporated in the assumptions used to develop the TMDLs and associated WLAs (see section on Margin of Safety).

❑ Seasonal variation

Seasonal variation is not a consideration for TMDLs based upon human health criteria for carcinogens since the duration for this type of criteria is a 70 year exposure. This duration is implemented through the use of average conditions for tributary flows (i.e., the harmonic mean flow), average tidal coefficients in the model used to develop the WLAs/TMDLs, and the historical median water temperature. Water temperature is the principal environmental parameter affecting the fate of DCE and PCE.

❑ Margin of Safety

A margin of safety is required to be included in a TMDL to account for any lack of knowledge concerning the relationships between pollutant loadings and receiving water quality. Commission regulations also require that a portion of the TMDL be set aside as a margin of safety, with the

proportion reflecting the degree of uncertainty in the data and resulting water quality-based controls.

For the volatile organics, the margin of safety is incorporated in the assumptions used to develop the TMDLs and associated WLAs. These assumptions include the use of design tributary and effluent flows, the use of technology-based standards for discharges where the effluent data is not of sufficient quantity and quality, and the use of technology-based effluent limitations for industrial discharges included in wasteload allocations. Furthermore, substantial scientific and technical effort has been devoted to identifying pollutants contributing to the impairment of the tidal Delaware River, and a fully calibrated and validated hydrodynamic and water quality model is available to develop the TMDLs and associated WLAs.

❑ Monitoring Plan

The Delaware River Basin Commission currently conducts ambient water quality monitoring in the Delaware River and Bay at 21 stations between the mouth of Delaware Bay and Fieldsboro, NJ between March and November of each year. As part of this monitoring program, samples for volatile organics are collected at 12 locations in the river reaches that are the subject of these TMDLs. This sampling effort was initiated in July 1999 for the purpose of obtaining data for all volatile organics for which the Commission has water quality criteria for human health protection, including DCE and PCE. The sampling effort includes 3 collections during the months of July, August and September and monthly collections in the other months. This effort will be continued for the next several years as part of the Commission's ambient monitoring programs in the basin. The Commission also conducts sampling at the head of tide of the major tributaries that are included in the water quality model. The results of this monitoring will be used to confirm the boundary loadings used in the model, and for reallocations that may be required in the future.

In addition, adoption of the assimilative capacity determination for the two volatile organics will permit the Commission's Executive Director to issue wasteload allocations or other effluent requirements to ensure that the loadings from the point sources that comprise the TMDLs are being achieved (see implementation plan).

❑ Implementation Plan

Current EPA regulations do not require an implementation plan to be included with TMDLs. Regardless of the regulatory requirement, the Commission and its signatory parties currently have in place an implementation procedure for utilizing wasteload allocations and other effluent requirements formally issued by the Commission's Executive Director. This procedure has been in use for over 25 years with wasteload allocations for carbonaceous oxygen demand that were developed for discharges to the estuary.

The resolution passed by the Commission at their meeting on January 26, 2000 stating that allocations of the assimilative capacity of the tidal Delaware River are necessary for two volatile organics, 1,2 - dichloroethane (DCE) and tetrachloroethene (PCE) included a direction to staff to

require dischargers to collect one year of effluent data prior to issuing final wasteload allocations or other effluent requirements. Draft wasteload allocations were developed by Commission staff for these two pollutants and presented in a report entitled "Wasteload Allocations for Volatile Organics and Toxicity: Phase I TMDLs for Toxic Pollutants in the Delaware River Estuary". This report was included in the public participation process that preceded the Commission's determination. Appendix 1 contains the section of the report on DCE, while Appendix 2 contains the section of the report on PCE.

Section 4.30.7B.2.c.6). of the Commission regulations requires that WLAs developed by the Commission shall be referred to the appropriate state agency for use, as appropriate, in developing effluent limitations, schedules of compliance and other effluent requirements in NPDES permits. It is anticipated that some WLAs will be converted into effluent limitations, others may require no new effluent limitation (e.g., an existing effluent limit is the same as the WLA), or more frequent monitoring may be requested in lieu of the issuance of a WLA. Meetings with state permitting staffs are planned to determine how each state agency will utilize WLAs and other effluent requirements that are issued by the Executive Director.

❑ Reasonable Assurance that the TMDLs will be Achieved

Data available to assess whether the TMDLs will be achieved include ambient water quality data collected by the Commission during routine surveys of Zones 2 through 6 of the Delaware River, and effluent quality data required through NPDES permits issued by state permitting authorities. Commission regulations also require that the WLAs be reviewed and, if required, revised every five years, or as directed by the Commission. This will ensure that additional discharges of the pollutant or increased non-point source loadings in the future will be considered.

Appendix 1

1,2 - Dichloroethane Section of
"Wasteload Allocations for Volatile Organics and Toxicity:
Phase I TMDLs for Toxic Pollutants in the Delaware River Estuary"
December 1998

1,2 - Dichloroethane

1,2 -Dichloroethane also known as DCE is one of the chlorinated ethanes that are produced in large quantities for the production of vinyl chloride, as industrial solvents, and as intermediates in the production of other organochlorine compounds (U.S. EPA, 1980a). Based upon data collected in 1990 and 1991 by the Commission, approximately 50 kilograms per day is released to the estuary in wastewater discharges from point sources.

Identification of Permittees

A discharge is included in the wasteload allocation study if it meets one of the following criteria [Section 4:30.7.B.2.c.3)]:

1. The discharge has an existing permit limit for the parameter.
2. Effluent data indicates the presence of the parameter, or
3. The reasonable potential exists for the parameter to occur in the discharge.

If the discharge is not included in the wasteload allocation exercise, its flow will be included in the hydraulic simulations, but its loading will be set to the water quality criteria.

By reviewing the Discharge Monitoring Reports (DMR) from 1992 to September 30, 1998, the Toxic Substance Data Base, and monitoring data collected in the fall of 1992, 51 discharges were identified meeting the criteria provided above. Among them, there were eight discharges which have existing permit limits for DCE, and eighteen discharges that are covered by effluent guidelines that have DCE limitations. The identified discharges and their respective DCE concentrations are listed in Table 4 for industrial discharges and Table 5 for municipal discharges.

Assignment of Initial Loadings

Each of the 51 discharges included in the allocation was assigned an initial loading based upon Section 4.30.7.B.2.c.4).b). 18 discharges were assigned initial loadings based upon the effluent limitations guideline of 68 µg/L. 19 discharges were assigned a value of 68 µg/L (the minimum performance standard) due to insufficient or highly variable monitoring results ($N < 6$ or $CV \geq 60$ %).

Wasteload Allocation Procedure

Establishing human health-based wasteload allocations is a two-step process which includes baseline and multiple discharge analyses. A one-dimensional model system WASP5, which consists of DYNHYD5 and TOXI5 models were utilized for this study, as well as, the Equal Marginal Percent Reduction (EMPR) procedure.

Hydraulic Simulations

The DYNHYD5 Model was utilized for simulating the water movement in the Delaware Estuary. The model's segmentation is comprised of two seaward boundaries, 11 tributaries, and the mainstem of the tidal Delaware River. One set of spatially-variable Manning coefficients which were determined as a result of the calibration/verification study of the DYNHYD5 Model was used for the model's input file in the wasteload allocation study. Average tidal coefficients were developed by using non-linear regression

analysis on the actual tide data collected by NOAA between August 5 and September 4, 1986. The average flow at Trenton during this one month period was 6300 cfs. It was close to the harmonic mean flow of Delaware River at Trenton (7208 cfs). In addition, this period covered a complete lunar cycle (spring and neap tides). The generated tidal coefficients therefore represent average tidal conditions under the harmonic mean flows.

The design effluent flows were determined according to Section 4.30.7.A.8. The design effluent flows are listed in Tables 1 and 2, and were used by the DYNHYD5 model as constant inflows. The Commission's carcinogen water quality criteria for DCE is the most stringent. Therefore, harmonic mean flows for all tributaries were used in the model simulations. One of the output files from DYNHYD5 containing hydraulic information would be used by the TOXI5 model for water quality simulations.

Water Quality Simulations

A TOXI5 model that was previously calibrated and validated for 1,2 - Dichloroethane in the Delaware Estuary (DRBC, 1998) was utilized to establish wasteload allocations. Several parameters were determined during the calibration/verification process. The dispersion coefficients for average conditions were determined by running the model for chlorides under harmonic mean flow conditions.

A variety of methods have been proposed to compute the liquid and gas phase transfer coefficients which determine the fate of volatile organics. Several of these methods are included in TOXI5, and may be invoked through the user's selection of one of the six volatilization options. In this study, option 4 was selected. Under this option, volatilization rates in flowing systems are calculated using reaeration rates calculated from Covar's method and a gas transfer rate of 100 m/day. The input data required for option 4 are listed in Table 6. In addition to volatilization, three other fate constants (hydrolysis, biodegradation, and oxidation) were also considered. Their constant loss rates were specified as $1x10^{-8}$, $1x10^{-4}$, and $1x10^{-6}$ (day^{-1}), respectively (Ambrose, 1987). The model's calibration/verification results indicate that sediment transport does not influence the transport and the fate of DCE, because DCE does not adsorb strongly to the sediment. Therefore, sediment transport was not considered in this WLA study. The available data showed no detectable DCE in the tributaries, therefore no tributary loadings were specified. A constant temperature of 18 °C was applied for all segments.

Baseline Analysis

To ensure that the model achieved a stable condition, a 60 day simulation period was used. It was determined that the numerical stability of the model was obtained after about 40 days.

There are seventy-six continuous point source discharges to the Delaware River estuary. Fifty-one out of them are included in the 1,2-Dichloroethane wasteload allocation study. Because the model achieves numerical stability after forty days, the last four days of a sixty day simulation were averaged in both the baseline and multiple analysis portions, and compared to the applicable stream quality objective to determine if there is any water quality violation.

In the baseline analysis portion of the EMPR procedure, each discharge is evaluated as if it was the only discharge to the estuary. In this analysis, each discharger is set to its initial loading while the other discharges are set to the applicable stream quality objective for the zone in which they discharge. Since the criteria for DCE vary widely between Zones 3, 4 and 5 (0.383, 98.6 and 17.2 $\mu g/L$, respectively), ambient concentrations that exceed the criterion result when discharges are set to the applicable stream

quality objective, particularly in the lower portions of Zone 3. Since the objective of using the criteria is to remove the assimilative capacity provided by the discharge flows that are included in the model. discharge concentrations were established for discharges of DCE to Zones 4 and 5 that will not result in exceedances of the water quality criterion in Zone 3. These concentrations were then used in the baseline analysis for the discharges to Zones 4 and 5 that were included in the exercise. A value of 17.3 μg/L was determined to be the appropriate concnetration for discharges to Zones 4 and 5. Discharges to Zones 2 and 3 were set to the applicable water quality criterion (0.383 μg/L).

If the discharge results in a water quality violation, the loading is reduced from the initial loading until the water quality criterion is met. Only 2 of the 51 discharges were reduced from their initial loading during the baseline analysis portion of the wasteload allocation (Table 7). The two discharges were Camden County MUA (78% reduction) and Philadelphia - NE (91% reduction) (Figures 1 and 2).

Multiple Analysis

The baseline loading of each of the 51 dischargers was used for the first run of multiple analysis. At baseline loading, water quality criterion is violated around river mile 95. To find out which zones contribute significantly to the violation, the next step was to reduce the loading of one zone at a time and keep the baseline loading of other zones unchanged. From Figures 3 - 6, it is evident that the discharges in Zone 5 don't have any significant contribution to water quality violation even though some large discharges like Dupont-Chambers Works, Star Enterprise, and City of Wilmington are in Zone 5.

Based upon this sensitivity analysis of loading reduction in different zones, eleven significant dischargers were selected for multiple analysis. In Zone 4, 85.73% of total baseline loadings are from Delcora (11.889 kg/day), Gloucester County (6.512 kg/day), Philadelphia - SW STP (1.272 kg/day), Sun Company - Point Breeze (1.527 kg/day), and Sun Company - Girard Point (1.585 kg/day). In Zone 2 and 3, 92.55% of total baseline loadings are from Camden County (4.756 kg/day), Philadelphia - NE STP (5.107 kg/day), Rohm & Hass - Philadelphia (DSN:001, 1.629 kg/day), Mount Holly Sewage Authority (1.351 kg/day), USX (3.440 kg/day), and Morrisville Borough (1.918 kg/day). By appling Equal Marginal Percent Reduction (EMPR), 58% of the baseline loading of each significant discharger was required to meet the stream quality objectives (Figure 7).

Conclusion

The wasteload allocations for 1,2 - Dichloroethane to protect human health from carcinogenic effects were established by following the procedures specified in Section 4.30.7 of the Commission's Water Quality Regulations. Fifty-one discharges were identified and evaluated in the wasteload allocation study. Philadelphia - NE STP and Camden County were the only two out of the fifty-one discharges whose initial loading was reduced by 91% and 78% respectively during the baseline analysis. The baseline load of each discharger is listed in Table 7. After the multiple analysis portion of the Equal Marginal Percent Reduction (EMPR) procedure was applied, the final multiple discharger loads for the selected discharges were established and listed in Table 7. A 58% reduction of baseline loading of each significant discharger in Zone 2,3 and 4 was required to meet the water quality criterion.

Table 4: Supporting Data for Industrial Dischargers Included in the Wasteload Allocation Study for 1,2-Dichloroethane.

PERMITTEE	NPDES #	ELG	DSN	µg/L					DESIGN FLOW (m^3/s)
				G[1]	P[1]	C[1]	M[1]	Assigned Conc.	
STAR ENTERPRISES	DE0000256	Yes	601	68.00				68.00	0.526
FORMOSA PLASTICS	DE0000612	Yes	001	68.00	65.50	1.50[a] 24[b] 57.94[c]		68.00	0.021
KANEKA DELAWARE	DE0000647	Yes	001	68.00	68.00	0.30 6 34.99		68.00	0.010
STANDARD CHLORINE	DE0020001	Yes	001	68.00	180.00	1.92 26 78.68		68.00	0.030
OCCIDENTAL CHEMICAL	DE0050911	Yes	001	68.00				68.00	0.011
DUPONT - CHAMBERS WORKS	NJ0005100	Yes	662	68.00	8.75 kg/day 108.74 µg/L	17.27[a] 78 119.30		68.00	1.001
DUPONT-EDGEMOOR	DE0000051		001			0.40[d] 3 109.00	68.00	68.00	0.171
IKO MANUFACTURING	DE0050857		001			0.30[d] 1	68.00	68.00	0.0004
GEON	NJ0000008 (NJ0004286)	Yes	001	68.00	0.19 kg/day 66.82 µg/L	1.74[f] 17 48.20		68.00	0.040
BAYWAY REFINING	PA0012637	Yes	201	68.00				68.00	0.142
BOEING HELICOPTERS	PA0013323	Yes	001	68.00				68.00	0.022
BOEING HELICOPTERS	PA0013323	Yes	002	68.00				68.00	0.004
HERCULES - GIBBSTOWN	NJ0005134	Yes	001	68.00	0.18 lb/day 70.80 µg/L	0.002[g] 4 35.29		68.00	0.014
AUSIMONT	NJ0005185	Yes	001	68.00		22.33[d] 3 74.16		68.00	0.031
SUN COMPANY - POINT BREEZE	PA0012629	Yes	002	68.00				68.00	0.247
SUN COMPANY - GIRARD POINT	PA0011533	Yes	015	68.00				68.00	0.257

PERMITTEE	NPDES #	ELG	DSN	µg/L					DESIGN FLOW (m^3/s)
				G[1]	P[1]	C[1]	M[1]	Assigned Conc.	
ROHM & HAAS - PHILADELPHIA	PA0012777		001			4.30 76 511.98	68.00	68.00	0.264
ROHM & HAAS - PHILADELPHIA	PA0012777		003				68.00	68.00	0.044
ROHM & HAAS - PHILADELPHIA	PA0012777		007				68.00	68.00	0.017
COLORITE POLYMERS	NJ0004391	Yes	001C	68.00	0.10 kg/day 95.04 µg/L	0.48[h] 3 71.96		68.00	0.012
ROHM & HAAS - BRISTOL	PA0012769	Yes	009	68.00	68.00	0.30 80 201.12		68.00	0.084
USX	PA0013463	Yes	103	68.00				68.00	0.558
PRE-FINISH METALS	PA0045021	Yes	001	68.00				68.00	0.007

1 G: Effluent Limitations Guideline P: Monthly Permit Limit C: Average Concentration from PCS M: Minimum Performance Standard.

a. Average Concentration.
b. Number of Observations.
c. Coefficient of Variation.
d. Toxic Substance Data base.
e. 21.259 MGD is used for calculation of concentration.
f. 0.757 MGD is used for calculation of concentration.
g. 0.312 MGD is used for calculation of concentration.
h. 0.275 MGD is used for calculation of concentration

Table 5: Supporting Data for Municipal Discharges Included in the Wasteload Allocation Study for 1,2 Dichloroethane.

PERMITTEE	NPDES #	DSN	µg/L				DESIGN FLOW (m^3/s)
			P[1]	C[1]	M[1]	Assigned Conc.	
CITY OF SALEM	NJ0024856	001		1.94[a] 8[b] 40.07[c]		1.94	0.061
PENNSVILLE SEWAGE AUTHORITY	NJ0021598	001		1.42 12 33.09		1.42	0.082
CARNEYS PT. SEWAGE AUTHORITY	NJ0021601	001		1.55 10 44.20		1.55	0.057
CITY OF WILMINGTON	DE0020320	001		5.37[d] 3 84.00	68.00	68.00	4.310
PENNS GROVE SEWAGE AUTHORITY	NJ0024023	001		5.00 4 0.00	68.00	68.00	0.033
LOGAN TOWNSHIP MUA	NJ0027545	001		1.27 7 16.82		1.27	0.044
DELCORA	PA0027103	001		36.20 60 748.73	68.00	68.00	1.927
GREENWICH TOWNSHIP	NJ0030333	001		1.09 8 68.58	68.00	68.00	0.044
GLOUCESTER COUNTY UA	NJ0024686	001		16.14 19 411.02	68.00	68.00	1.056
PHILADELPHIA - SOUTHWEST STP	PA0026671	001		1.60 48 54.00		1.60	8.760
CAMDEN COUNTY MUA	NJ0026182	001		1.22 17 100.93	68.00	68.00	3.504
PHILADELPHIA - SOUTHEAST STP	PA0026662	001		1.60 49 56.05		1.60	4.960
PHILADELPHIA - NORTHEAST STP	PA0026689	001		6.90 54 298.18	68.00	68.00	9.198
PALMYRA BOROUGH	NJ0024449	001		2.72 3 74.22	68.00	68.00	0.035

PERMITTEE	NPDES #	DSN	µg/L				DESIGN FLOW (m^3/s)
			P[1]	C[1]	M[1]	Assigned Conc.	
CINNAMINSON	NJ0024007	001		1.44 9 47.22		1.44	0.088
RIVERTON BOROUGH	NJ0021610	001		3.402	68.00	68.00	0.010
DELRAN SEWAGE AUTHORITY	NJ0023507	001		1.84 25 102.20	68.00	68.00	0.110
MOUNT HOLLY SA	NJ0024015	001		0.032 (mg/kg[2])	68.00	68.00	0.219
WILLINGBORO	NJ0023361	001		1.68 18 47.20		1.68	0.229
RIVERSIDE SEWAGE AUTHORITY	NJ0022519	001		1.50 5 40.82	68.00	68.00	0.044
MT. LAUREL TOWNSHIP	NJ0025178	001		2.28 20 62.36		2.28	0.263
BEVERLY SEWAGE AUTHORITY	NJ0027481	001		0.58 16 36.75		0.58	0.044
BURLINGTON TOWNSHIP	NJ0021709	001		1.43 15 61.65		1.43	0.160
FLORENCE TOWNSHIP	NJ0023701	001		1.56 16 43.52		1.56	0.066
BORDENTOWN	NJ0024678	001		0.50 16 0.00		0.50	0.137
HAMILTON TOWNSHIP	NJ0026301	001		0.83 16 60.19		0.83	0.701
MORRISVILLE BOROUGH	PA0026701	001		77.90 13 [illegible]	68.00	68.00	0.311
SWEDEBORO	NJ0022024	001		0.40 1	68.00	68.00	0.015

1 P: Monthly Permit Limit C: Average Concentration from PCS M: Minimum Performance Standard

a. Average Concentration.

b. Number of Observations.

c. Coefficient of Variation.

d Toxic Substance Data Base.

Table 6: Input data required for volatilization option 4.

Variable	Input Values
Water Body Type (0 = flowing; 1 = quiescent)	0
Molecular Weight of 1,2 - Dichloroethane	99.0
Volatilization Options	4
Henry's Law constant, atm-m^3/mole	0.00914
Volatilization Temperature Correction Factor	1.024

Table 7: Results of Baseline and Multiple Discharges Analysis for 1,2-Dichloroethane.

PERMITTEE	NPDES #	DSN	Design Flow (m^3/s)	Assigned Conc. ($\mu g/L$)	Initial Load (kg/day) (5% Reserve)	Baseline Analysis % Reduction	Baseline Load (kg/day)	Multiple Analysis % Reduction	Multiple Load (kg/day)	Final WLA Conc. ($\mu g/L$)
CITY OF SALEM	NJ0024856	001	0.0610	1.94	0.011	0.00	0.011	0.00	0.011	1.94
STAR ENTERPRISES	DE0000256	601	0.5260	68.00	3.242	0.00	3.242	0.00	3.242	68.00
FORMOSA PLASTICS CORP.	DE0000612	001	0.0210	68.00	0.132	0.00	0.132	0.00	0.132	68.00
KANEKA DELAWARE	DE0000647	001	0.0100	68.00	0.061	0.00	0.061	0.00	0.061	68.00
STANDARD CHLORINE	DE0020001	001	0.0300	68.00	0.184	0.00	0.184	0.00	0.184	68.00
OCCIDENTAL CHEMICAL CORP.	DE0050911	001	0.0110	68.00	0.068	0.00	0.068	0.00	0.068	68.00
DUPONT - CHAMBERS WORKS	NJ0005100	662	0.9530	68.00	5.879	0.00	5.879	0.00	5.879	68.00
PENNSVILLE SEWAGE AUTHORITY	NJ0021598	001	0.0820	1.42	0.011	0.00	0.011	0.00	0.011	1.42
CARNEYS POINT SEWAGE AUTHORITY	NJ0021601	001	0.0570	1.55	0.008	0.00	0.008	0.00	0.008	1.55
DUPONT-EDGEMOOR	DE0000051	001	0.1710	68.00	1.054	0.00	1.054	0.00	1.054	68.00
CITY OF WILMINGTON	DE0020320	001	4.3120	68.00	26.598	0.00	26.598	0.00	26.598	68.00
IKO MANUFACTURING INC.	DE0050857	001	0.0004	68.00	0.003	0.00	0.003	0.00	0.003	68.00
PENNS GROVE SEWAGE AUTHORITY	NJ0024023	001	0.0330	68.00	0.203	0.00	0.203	0.00	0.203	68.00
GEON	NJ0004286	001	0.0400	68.00	0.244	0.00	0.244	0.00	0.244	68.00
LOGAN TOWNSHIP MUA	NJ0027545	001	0.0440	1.27	0.005	0.00	0.005	0.00	0.005	1.27

PERMITTEE	NPDES #	DSN	Design Flow (m^3/s)	Assigned Conc. (µg/L)	Initial Load (kg/day) (5% Reserve)	Baseline Analysis % Reduction	Baseline Load (kg/day)	Multiple Analysis % Reduction	Multiple Load (kg/day)	Final WLA Conc. (µg/L)
BAYWAY MANUFACTURING	PA0012637	201	0.1420	68.00	0.878	0.00	0.878	0.00	0.878	68.00
DELCORA	PA0027103	001	1.9270	68.00	11.889	0.00	11.889	58.00	4.993	28.56
BOEING HELICOPTERS	PA0013323	001	0.0220	68.00	0.135	0.00	0.135	0.00	0.135	68.00
BOEING HELICOPTERS	PA0013323	002	0.0040	68.00	0.026	0.00	0.026	0.00	0.026	68.00
GREENWICH TOWNSHIP	NJ0030333	001	0.0440	68.00	0.270	0.00	0.270	0.00	0.270	68.00
HERCULES - GIBBSTOWN	NJ0005134	001	0.0140	68.00	0.087	0.00	0.087	0.00	0.087	68.00
GLOUCESTER COUNTY UA	NJ0024686	001	1.0560	68.00	6.512	0.00	6.512	58.00	2.735	28.56
AUSIMONT	NJ0005185	001	0.0310	68.00	0.189	0.00	0.189	0.00	0.189	68.00
PHILADELPHIA - SOUTHWEST STP	PA0026671	001	8.7600	1.60	1.272	0.00	1.272	58.00	0.534	0.67
SUN CO. - POINT BREEZE	PA0012629	002	0.2470	68.00	1.527	0.00	1.527	58.00	0.641	28.56
SUN CO. - GIRARD POINT	PA0011533	015	0.2570	68.00	1.585	0.00	1.585	58.00	0.666	28.56
CAMDEN COUNTY MUA	NJ0026182	001	3.5040	68.00	21.616	78.00	4.756	58.00	1.997	6.28
PHILADELPHIA - SOUTHEAST STP	PA0026662	001	4.9600	1.60	0.720	0.00	0.720	0.00	0.720	1.60
PHILADELPHIA - NORTHEAST STP	PA0026689	001	9.1980	68.00	56.742	91.00	5.107	58.00	2.145	2.57
ROHM & HAAS - PHILADELPHIA	PA0012777	007	0.0170	68.00	0.104	0.00	0.104	0.00	0.104	68.00
ROHM & HAAS - PHILADELPHIA	PA0012777	001	0.2640	68.00	1.629	0.00	1.629	58.00	0.684	28.56

PERMITTEE	NPDES #	DSN	Design Flow (m^3/s)	Assigned Conc. ($\mu g/L$)	Initial Load (kg/day) (5% Reserve)	Baseline Analysis % Reduction	Baseline Load (kg/day)	Multiple Analysis % Reduction	Multiple Load (kg/day)	Final WLA Conc. ($\mu g/L$)
ROHM & HAAS - PHILADELPHIA	PA0012777	003	0.0440	68.00	0.273	0.00	0.273	0.00	0.273	68.00
PALMYRA BOROUGH	NJ0024449	001	0.0350	68.00	0.213	0.00	0.213	0.00	0.213	68.00
CINNAMINSON	NJ0024007	001	0.0880	1.44	0.011	0.00	0.011	0.00	0.011	1.44
RIVERTON BOROUGH	NJ0021610	001	0.0100	68.00	0.059	0.00	0.059	0.00	0.059	68.00
DELRAN SEWAGE AUTHORITY	NJ0023507	001	0.1100	68.00	0.676	0.00	0.676	0.00	0.676	68.00
MOUNT HOLLY SEWAGE AUTHORITY	NJ0024015	001	0.2190	68.00	1.351	0.00	1.351	58.00	0.567	28.56
WILLINGBORO MUNICIPALITY	NJ0023361	001	0.2290	1.68	0.035	0.00	0.035	0.00	0.035	1.68
RIVERSIDE SEWAGE AUTHORITY	NJ0022519	001	0.0440	68.00	0.270	0.00	0.270	0.00	0.270	68.00
MOUNT LAUREL TOWNSHIP	NJ0025178	001	0.2630	2.28	0.054	0.00	0.054	0.00	0.054	2.28
BEVERLY SEWAGE AUTHORITY	NJ0027481	001	0.0440	0.58	0.002	0.00	0.002	0.00	0.002	0.58
BURLINGTON TOWNSHIP	NJ0021709	001	0.1600	1.43	0.021	0.00	0.021	0.00	0.021	1.43
COLORITE POLYMERS	NJ0004391	001	0.0120	68.00	0.077	0.00	0.077	0.00	0.077	68.00
ROHM & HAAS - BRISTOL	PA0012769	009	0.0840	68.00	0.517	0.00	0.517	0.00	0.517	68.00
FLORENCE TOWNSHIP	NJ0023701	001	0.0660	1.56	0.009	0.00	0.009	0.00	0.009	1.56
USX	PA0013463	103	0.5580	68.00	3.440	0.00	3.440	58.00	1.445	28.56
BORDENTOWN	NJ0024678	001	0.1310	0.50	0.006	0.00	0.006	0.00	0.006	0.50

PERMITTEE	NPDES #	DSN	Design Flow (m^3/s)	Assigned Conc. ($\mu g/L$)	Initial Load (kg/day) (5% Reserve)	Baseline Analysis % Reduction	Baseline Load (kg/day)	Multiple Analysis % Reduction	Multiple Load (kg/day)	Final WLA Conc. ($\mu g/L$)
HAMILTON TOWNSHIP	NJ0026301	001	0.7010	0.83	0.053	0.00	0.053	0.00	0.053	0.83
PRE-FINISH METALS	PA0045021	001	0.0070	68.00	0.042	0.00	0.042	0.00	0.042	68.00
MORRISVILLE BOROUGH	PA0026701	001	0.3110	68.00	1.918	0.00	1.918	58.00	0.806	28.56
SWEDESBORO	NJ0022021	001	0.0150	68.00	0.095	0.00	0.095	0.00	0.095	68.00

Figure 1 - Baseline Analysis for Camden County

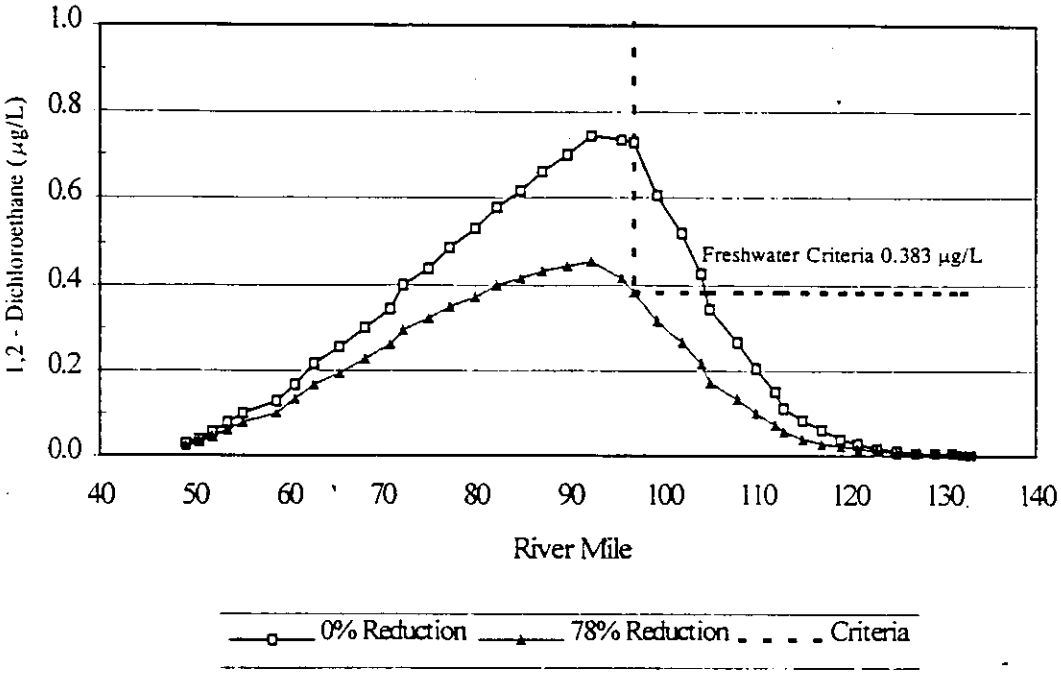


Figure 2- Baseline Analysis for Philadelphia - NE STP

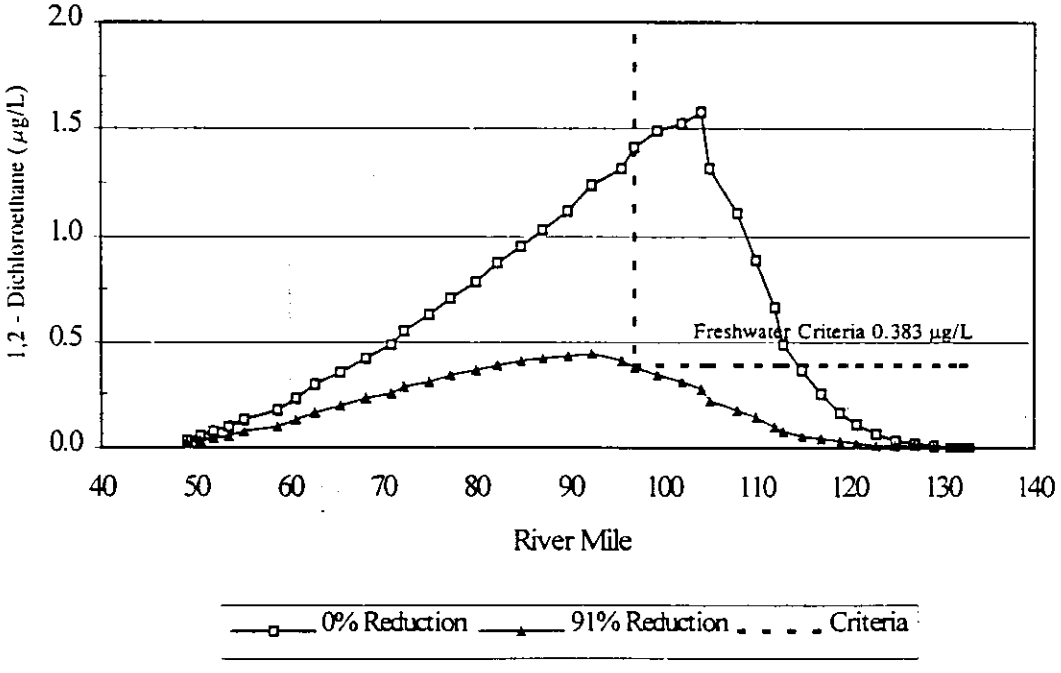


Figure 3 - Multiple Analysis - Reduction of Loading in Zone 5

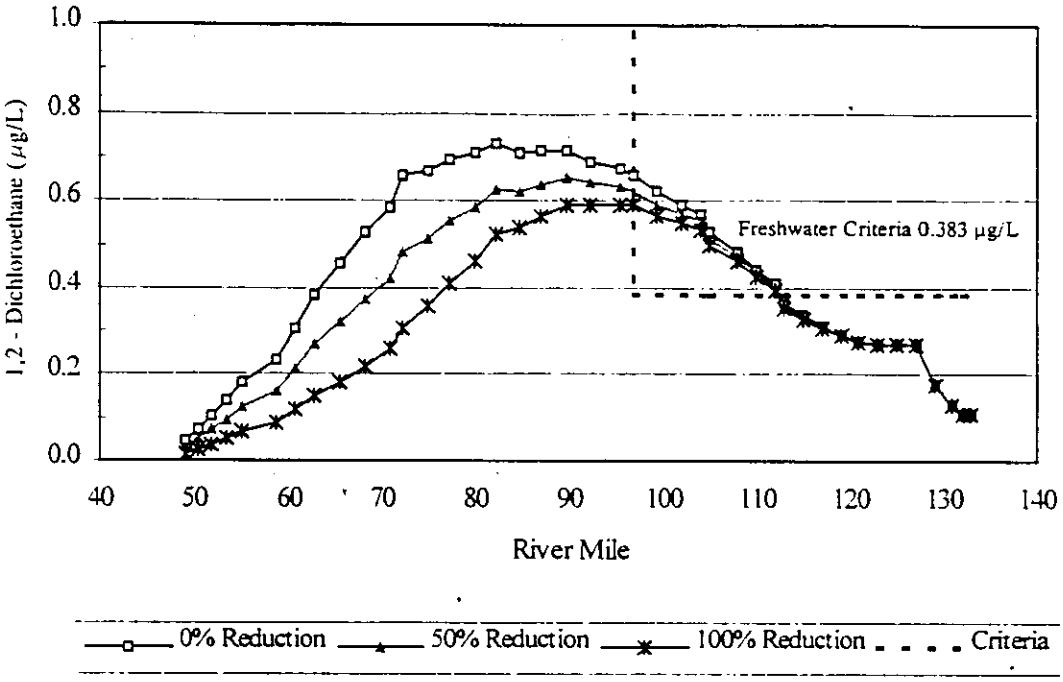


Figure 4 - Multiple Analysis - Reduction of Loading in Zone 4

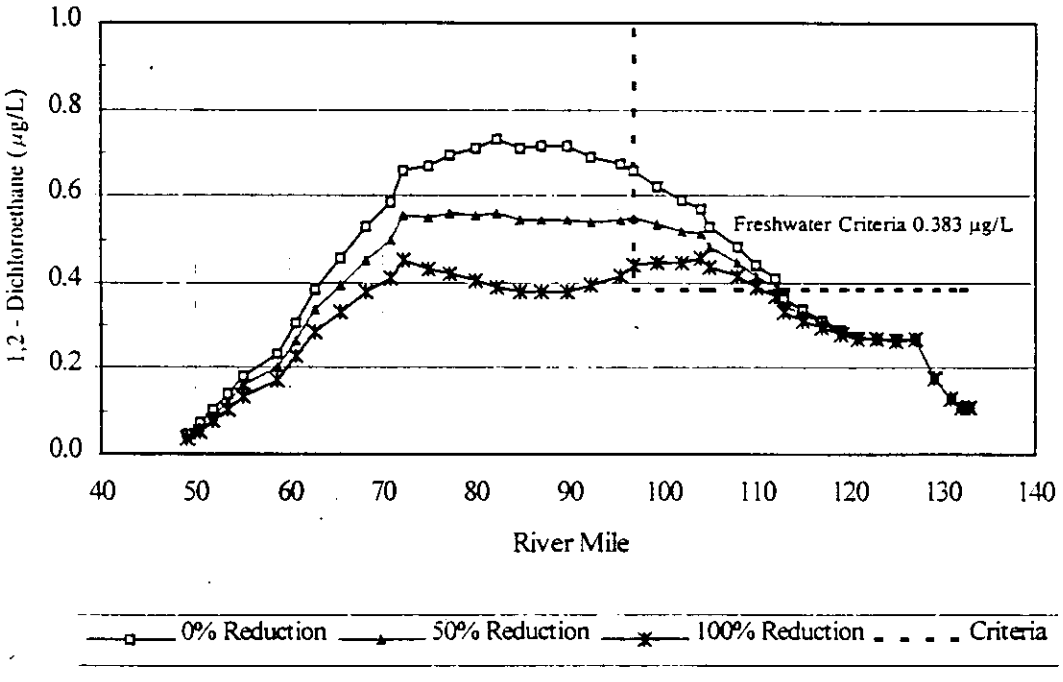


Figure 5 - Multiple Analysis - Reduction of Loading in Zone 2& 3

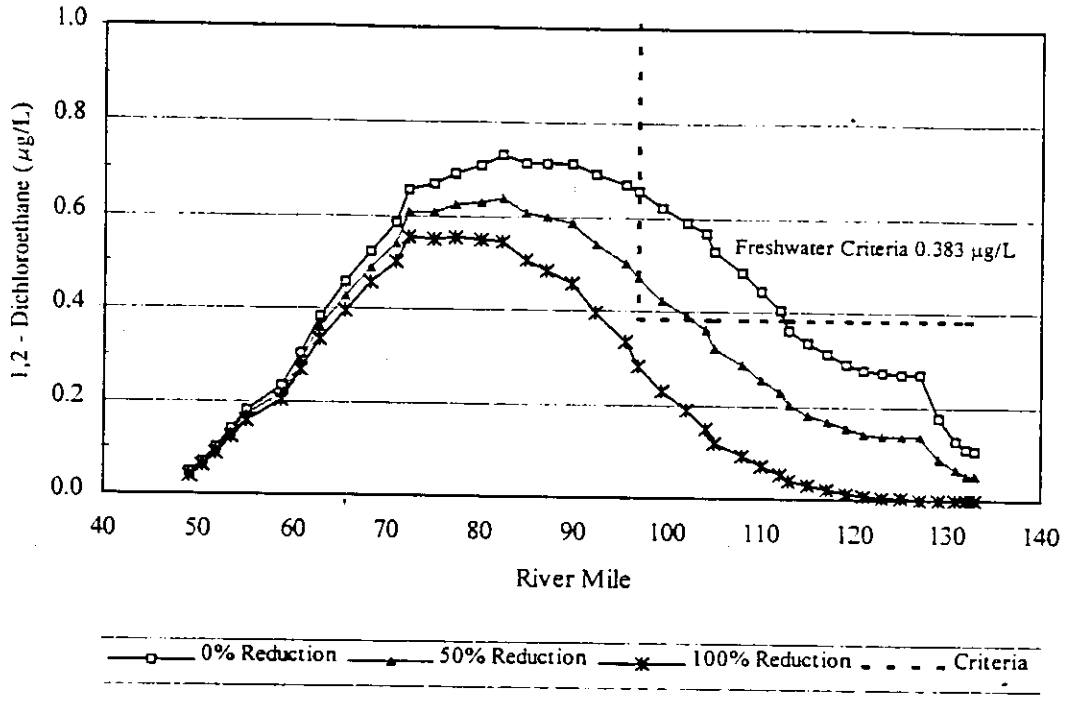


Figure 6 - Effect of Reduction of Baseline Load

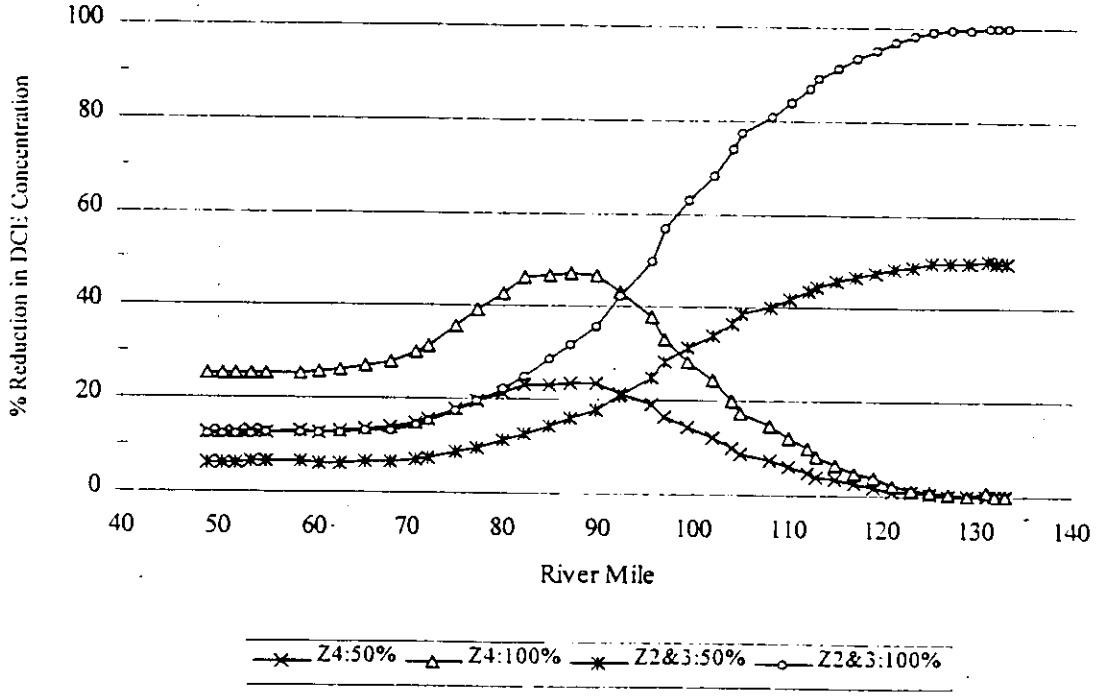
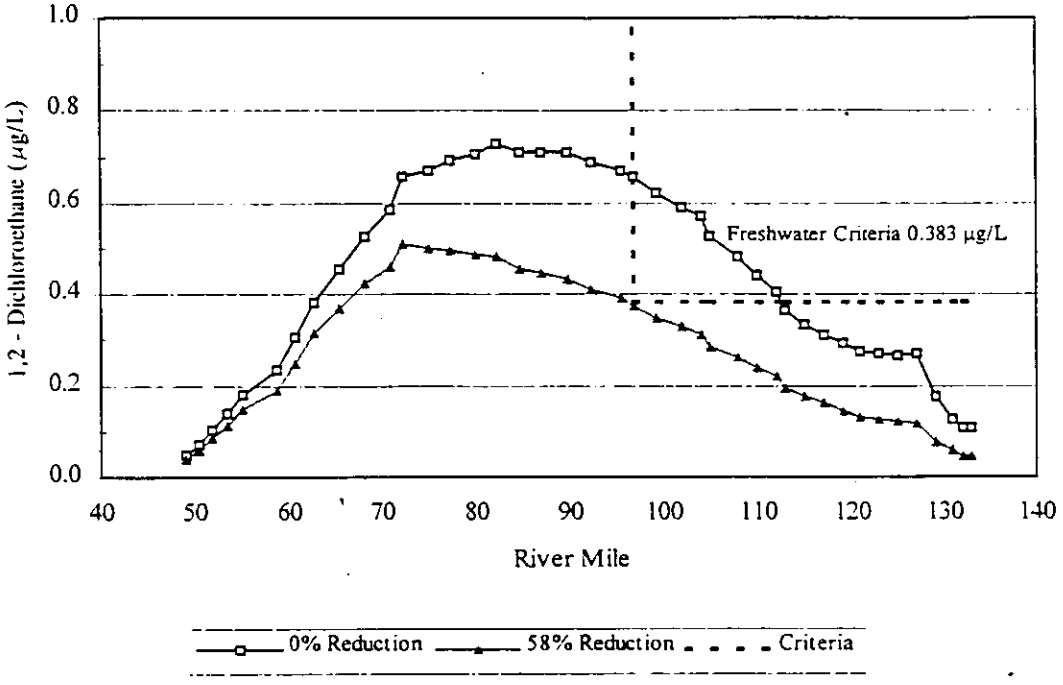


Figure 7 - Multiple Analysis - Reduction of Significant Loads



Appendix 2

Tetrachloroethene Section of
"Wasteload Allocations for Volatile Organics and Toxicity:
Phase I TMDLs for Toxic Pollutants in the Delaware River Estuary"
December 1998

Tetrachloroethene

Tetrachloroethene, also known as perchloroethylene or PCE, is used primarily as a solvent in the dry cleaning industry, and also as an industrial solvent (U.S. EPA, 1980b). Based upon data collected in 1990 and 1991 by the Commission, approximately 34 kilograms per day is released to the estuary in wastewater discharges from point sources.

Identification of Permittees

Forty out of seventy-six discharges were identified that meet the criteria specified in Section 4:30.7.B.2.c.3) (Table 8). There were five discharges that have existing permit limits for PCE, and ten industrial discharges that are covered by effluent guidelines.

Assignment of Initial Loadings

Each of the forty discharges included in the allocation was assigned an initial loading based upon Section 4.30.7.B.2.c.4).b) (Table 8). Ten discharges were assigned initial loadings based upon the effluent limitations guideline of 22 µg/L. Seven discharges were assigned loadings based upon actual effluent data. Twenty-three discharges were assigned a value of 22 µg/l (the minimum performance standard) due to insufficient or highly variable monitoring results ($N < 6$ or $CV \geq 60$ %). The loading of the discharges not included in the wasteload allocation were assigned the stream quality objectives for PCE according to its location.

Wasteload Allocation Procedure

A two-step process including baseline and multiple discharge analyses was used to establish human health-based wasteload allocations for PCE. The parameters used for hydraulic simulations were the same as those used for DCE. The DYNHYD5 model was set to simulate a 60-day run under the harmonic mean flows. The predominant transformation rate is the volatilization rate. It is calculated by the TOXI5 model for each segment throughout the simulation. The fate constants of biodegradation and oxidation were also considered in the simulations, and they were specified as $1x10^{-4}$ and $1x10^{-6}$, respectively (Ambrose, 1987). A constant temperature of 18 °C was utilized for all river segments. The TOXIWASP model parameters are listed in Table 9.

Baseline Analysis

In both the baseline and multiple analysis portions of the wasteload allocation, the last four days of a sixty day simulation are averaged and compared to the applicable stream quality objectives to check for any water quality violation.

Every discharge included in the wasteload allocation study has its own baseline analysis in which the loading listed in Table 8 is assigned to the discharge and the other discharges are set to the stream quality objective according to its location. For example, in the baseline analysis of Philadelphia - NE STP, the concentration used in calculating this discharge's loading is 22.0 µg/l (Table 8), 1.55 µg/l is assigned to the discharges located in Zone 5 below RM 68.75, 8.85 µg/L is assigned to the discharges located in Zone 5 above RM 68.75 and in Zone 4, and 0.8 µg/L is assigned to the discharges located in Zones 2 and 3. If there is water quality violation, the loading of the individual discharge is reduced until no violation occurs.

Table 10 list the results of the baseline analysis. Only 1 of the 39 discharges (Hamilton Township) was reduced from its initial loading (40% reduction) during this portion of the wasteload allocation (Figure 14).

Multiple Analysis

The baseline loading of each of the 40 discharges was used for the first run of the multiple discharge analysis. With the discharges set at baseline loading, the stream quality objective is violated in lower Zone 3 between river miles 95 and 105 (Figure 15). To find out which zones contributes significantly to the violation, the next step was to reduce the loading of one zone at a time and keep the baseline loading of other zones constant. From Figures 15 - 18, it is evident that only the discharges in Zones 2 & 3 significantly contribute to the water quality violation. Seven significant discharges to Zones 2 and 3 were selected for the multiple analysis: Camden County (6.993 kg/day), Philadelphia - SE (0.945 kg/day), Philadelphia - NE (18.358 kg/day), Lower Bucks County JMUA (0.874 kg/day), USX (1.113 kg/day), Hamilton Township (0.839 kg/day), and Morrisville Borough (0.621 kg/day). A 45% reduction of each of the seven discharges is required to meet the stream quality objective. The loading of each discharger resulting from the multiple analysis is listed in Table 10.

Conclusions

The wasteload allocations for Tetrachloroethene to protect human health from carcinogenic effects are established by following the procedures specified in Section 4.30.7 of the Commission's Water Quality Regulations. Forty discharges were identified and evaluated in the wasteload allocation study. Hamilton Township was the only discharger whose loading was reduced by 40% during the baseline analysis. An additional reduction of 45% was required of seven significant discharges located in Zones 2 and 3 in order to meet the stream quality objective.

Table 8: Supporting Data for Dischargers Included in the Wasteload Allocation Study for Tetrachloroethene.

PERMITTEE	NPDES #	ELG	DSN	µg/L					DESIGN FLOW (m^3/s)
				G[1]	P[1]	C[1]	M[1]	Assigned Conc.	
CITY of SALEM	NJ0024856		001			2.01[a] 8[b] 77.68[c]	22.00	22.00	0.061
FORMOSA PLASTICS CORP.	DE0000612	Yes	001	22.00	20.10	0.85 7 28.46		22.00	0.021
KANEKA DELAWARE	DE0000647	Yes	001	22.00	22.00	0.60 6 28.06		22.00	0.012
STANDARD CHLORINE	DE0020001	Yes	001	22.00	22.00	1.93 26 91.09		22.00	0.030
DUPONT-CHAMBER WORKS	NJ0005100	Yes	662	22.00		0.094[f] 63 144.28		22.00	1.001
PENNSVILLE SEWERAGE AUTHORITY	NJ0021598		001			1.667 12 61.79		1.67	0.082
CARNEYS PT. SEWAGE AUTHORITY	NJ0021601		001			1.50 10 70.27	22.00	22.00	0.057
CITY OF WILMINGTON	DE0020320		001			0.13[a] 3	22.00	22.00	4.310
PENNS GROVE SEWERAGE AUTHORITY	NJ0024023		001			6.84 5 111.37	22.00	22.00	0.033
GEON	NJ0000008 (NJ0004286)	Yes	001	22.00	0.062 kg/day	0.0044[f] 17 58.06		22.00	0.040
LOGAN TOWNSHIP MUA	NJ0027545		001			1.285 7 37.95		1.29	0.044
DUPONT-REPAUNO	NJ0004219		001			1.40[a] 3	22.00	22.00	0.644
GREENWICH TOWNSHIP	NJ0030333		001			1.209 8 37.24		1.21	0.044
HERCULES-GIBBSTOWN	NJ0005134	Yes	001	22.00	0.059 lb/day	0.0013 4 23.09		22.00	0.014
GLOUCESTER COUNTY UTILITIES AUTHORITY	NJ0024686		001			1.334 19 47.67		1.33	1.056
AUSIMONT	NJ0005185	Yes	001	22.00		1.31 2 4.31		22.00	0.031
PHILADELPHIA - SW	PA0026671		001			9.70 52 388.56	22.00	22.00	8.760

PERMITTEE	NPDES #	ELG	DSN	µg/L					DESIGN FLOW (m^3/s)
				G[1]	P[1]	C[1]	M[1]	Assigned Conc.	
CAMDEN COUNTY M.U.A.	NJ0026182		001			1.51 17 75.34	22.00	22.00	3.504
PHILADELPHIA - SE	PA0026662		001			2.10 53 59.00		2.10	5.241
PHILADELPHIA - NE	PA0026689		001			3.50 48 156.42	22.00	22.00	9.198
PALMYRA BOROUGH	NJ0024449		001			2.58 3 82.31	22.00	22.00	0.035
CINNAMINSON	NJ0024007		001			1.667 9 94.87	22.00	22.00	0.088
RIVERTON BOROUGH	NJ0021610		001			0.5 2	22.00	22.00	0.010
DELRAN SEWERAGE AUTHORITY	NJ0023507		001			1.35 26 90.47	22.00	22.00	0.110
MOUNT HOLLY SEWAGE AUTHORITY	NJ0024015		001			0.013 13 148.52	22.00	22.00	0.219
WILLINGBORO MUN.	NJ0023361		001			0.45 5 24.85	22.00	22.00	0.229
RIVERSIDE STP	NJ0022519		001			1.70 5 64.44	22.00	22.00	0.044
MT. LAUREL TOWNSHIP	NJ0025178		001			2.73 21 72.50	22.00	22.00	0.263
BEVERLY SEWERAGE AUTHORITY	NJ0027481		001			0.491 16 7.64		0.49	0.044
BURLINGTON TWP	NJ0021709		001			1.03 15 88.59	22.00	22.00	0.160
COLORITE POLYMERS COMPANY	NJ0004391	Yes	001	22 (a)		0.0002[1] 3		22.00	0.012
ROHM & HAAS-BRISTOL	PA0012769	Yes	009	22 (a)		0.33 81 195.14		22.00	0.084
LOWER BUCKS COUNTY JMUA	PA0026468		001			600.00	22.00	22.00	0.438
FLORENCE TOWNSHIP	NJ0023701		001			1.50 16 68.85	22.00	22.00	0.066
USX	PA0013463	Yes	403	22 (a)		0.2 1		22.00	0.558

PERMITTEE	NPDES #	ELG	DSN	µg/L					DESIGN FLOW (m^3/s)
				G[1]	P[1]	C[1]	M[1]	Assigned Conc.	
BORDENTOWN	NJ0024678		001			0.67 16 83.12	22.00	22.00	0.131
HAMILTON TOWNSHIP	NJ0026301		001			2.86 16 300.59	22.00	22.00	0.701
CITY OF TRENTON	NJ0020923		001			0.563 16 57.38		0.56	0.876
MORRISVILLE BORO	PA0026701		001			0.118 13 353.38	22.00	22.00	0.311
SWEDEBORO	NJ0022024		001			1.10 1	22.00	22.00	0.015

1 G: Effluent Limitations Guideline P: Monthly Permit Limit C: Average Concentration from PCS
M: Minimum Performance Standard.

a. Average Concentration.

b. Number of Points.

c. Coefficient of Variation.

d. DRBC Monitoring Program data (µg/L) collected in September and October 1992.

e. Toxic Substance Data Base.

f. kg/day.

Table 9: Input data required for volatilization option 4.

Variable	Input Values
Water Body Type (0 = flowing; 1 = quiescent)	0
Molecular Weight of Tetrachloroethene	165.8
Volatilization Options	4
Henry's Law constant, atm-m^3/mole	0.0153
Volatilization Temperature Correction Factor	1.024

Table 10: Wasteload Allocations for Tetrachloroethene for Delaware River Estuary Discharges.

PERMITTEE	NPDES #	DSN	Design Flow (m^3/s)	Assigned Conc. ($\mu g/L$)	Initial Load (kg/day) (5% Reserve)	Baseline Analysis % Reduction	Baseline Load (kg/day)	Multiple Analysis % Reduction	Multiple Load (kg/day)	Final WLA Conc. ($\mu g/L$)
CITY OF SALEM	NJ0024856	001	0.06132	22.00	0.122	0.00	0.122	0.00	0.122	22.00
FORMOSA PLASTICS CORP.	DE0000612	001	0.02146	22.00	0.043	0.00	0.043	0.00	0.043	22.00
KANEKA DELAWARE	DE0000647	001	0.00986	22.00	0.020	0.00	0.020	0.00	0.020	22.00
STANDARD CHLORINE	DE0020001	001	0.02978	22.00	0.059	0.00	0.059	0.00	0.059	22.00
DUPONT - CHAMBERS WORKS	NJ0005100	662	0.95292	22.00	1.902	0.00	1.902	0.00	1.902	22.00
PENNSVILLE SEWAGE AUTHORITY	NJ0021598	001	0.08213	1.67	0.012	0.00	0.012	0.00	0.012	1.67
CARNEYS POINT SEWAGE AUTHORITY	NJ0021601	001	0.05694	22.00	0.114	0.00	0.114	0.00	0.114	22.00
CITY OF WILMINGTON	DE0020320	001	4.31156	22.00	8.605	0.00	8.605	0.00	8.605	22.00
PENNS GROVE SEWAGE AUTHORITY	NJ0024023	001	0.03285	22.00	0.066	0.00	0.066	0.00	0.066	22.00
GEON	NJ0004286	001	0.03951	22.00	0.079	0.00	0.079	0.00	0.079	22.00
LOGAN TOWNSHIP MUA	NJ0027545	001	0.04380	1.29	0.005	0.00	0.005	0.00	0.005	1.29
DUPONT - REPAUNO	NJ0004219	001	0.64395	22.00	1.285	0.00	1.285	0.00	1.285	22.00
GREENWICH TOWNSHIP	NJ0030333	001	0.04380	1.21	0.005	0.00	0.005	0.00	0.005	1.21
HERCULES - GIBBSTOWN	NJ0005134	001	0.01415	22.00	0.028	0.00	0.028	0.00	0.028	22.00

PERMITTEE	NPDES #	DSN	Design Flow (m^3/s)	Assigned Conc. ($\mu g/L$)	Initial Load (kg/day) (5% Reserve)	Baseline Analysis % Reduction	Baseline Load (kg/day)	Multiple Analysis % Reduction	Multiple Load (kg/day)	Final WLA Conc. ($\mu g/L$)
GLOUCESTER COUNTY UA	NJ0024686	001	1.05558	1.33	0.127	0.00	0.127	0.00	0.127	1.33
AUSIMONT	NJ0005185	001	0.03070	22.00	0.061	0.00	0.061	0.00	0.061	22.00
PHILADELPHIA - SOUTHWEST STP	PA0026671	001	8.76000	22.00	17.484	0.00	17.484	0.00	17.484	22.00
CAMDEN COUNTY MUA	NJ0026182	001	3.50400	22.00	6.993	0.00	6.993	45.00	3.846	12.10
PHILADELPHIA - SOUTHEAST STP	PA0026662	001	4.96048	2.10	0.945	0.00	0.945	45.00	0.520	1.16
PHILADELPHIA - NORTHEAST STP	PA0026689	001	9.19800	22.00	18.358	0.00	18.358	45.00	10.097	12.10
PALMYRA BOROUGH	NJ0024449	001	0.03460	22.00	0.069	0.00	0.069	0.00	0.069	22.00
CINNAMINSON	NJ0024007	001	0.08760	22.00	0.175	0.00	0.175	0.00	0.175	22.00
RIVERTON BOROUGH	NJ0021610	001	0.00964	22.00	0.019	0.00	0.019	0.00	0.019	22.00
DELRAN SEWAGE AUTHORITY	NJ0023507	001	0.10950	22.00	0.219	0.00	0.219	0.00	0.219	22.00
MOUNT HOLLY SEWAGE AUTHORITY	NJ0024015	001	0.21900	22.00	0.437	0.00	0.437	0.00	0.437	22.00
WILLINGBORO	NJ0023361	001	0.22864	22.00	0.456	0.00	0.456	0.00	0.456	22.00
RIVERSIDE SEWAGE AUTHORITY	NJ0022519	001	0.04380	22.00	0.087	0.00	0.087	0.00	0.087	22.00
MOUNT LAUREL TOWNSHIP	NJ0025178	001	0.26280	22.00	0.525	0.00	0.525	0.00	0.525	22.00

PERMITTEE	NPDES #	DSN	Design Flow (m^3/s)	Assigned Conc. ($\mu g/L$)	Initial Load (kg/day) (5% Reserve)	Baseline Analysis % Reduction	Baseline Load (kg/day)	Multiple Analysis % Reduction	Multiple Load (kg/day)	Final WLA Conc. ($\mu g/L$)
BEVERLY SEWAGE AUTHORITY	NJ0027481	001	0.04380	0.49	0.002	0.00	0.002	0.00	0.002	0.49
BURLINGTON TOWNSHIP	NJ0021709	001	0.15987	22.00	0.319	0.00	0.319	0.00	0.319	22.00
COLORITE POLYMERS	NJ0004391	001	0.01244	22.00	0.025	0.00	0.025	0.00	0.025	22.00
ROHM & HAAS - BRISTOL	PA0012769	009	0.08388	22.00	0.167	0.00	0.167	0.00	0.167	22.00
FLORENCE TOWNSHIP	NJ0023701	001	0.06570	22.00	0.131	0.00	0.131	0.00	0.131	22.00
LOWER BUCKS COUNTY JMUA	PA0026468	001	0.43800	22.00	0.874	0.00	0.874	45.00	0.481	12.10
USX	PA0013463	103	0.55757	22.00	1.113	0.00	1.113	45.00	0.612	12.10
BORDENTOWN	NJ0024678	001	0.13140	22.00	0.262	0.00	0.262	0.00	0.262	22.00
HAMILTON TOWNSHIP	NJ0026701	001	0.70080	22.00	1.399	40.00	0.839	45.00	0.462	7.26
CITY OF TRENTON	NJ0020923	001	0.876	0.56	0.045	0.00	0.045	0.00	0.045	0.56
MORRISVILLE BOROUGH	PA0026701	001	0.31098	22.00	0.621	0.00	0.621	45.00	0.341	12.10
SWEDESBORO	NJ0022021	001	0.01533	22.00	0.031	0.00	0.031	0.00	0.031	22.00

Figure 8 - Baseline Analysis for DuPont-Chambers Works

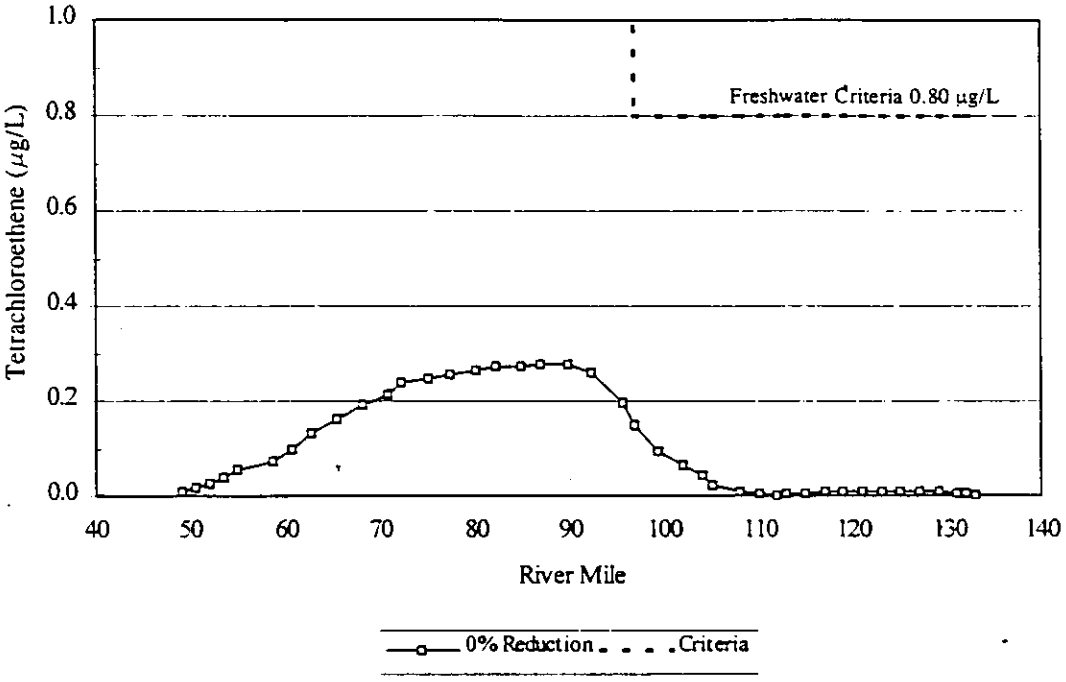


Figure 9 - Baseline Analysis for City of Wilmington

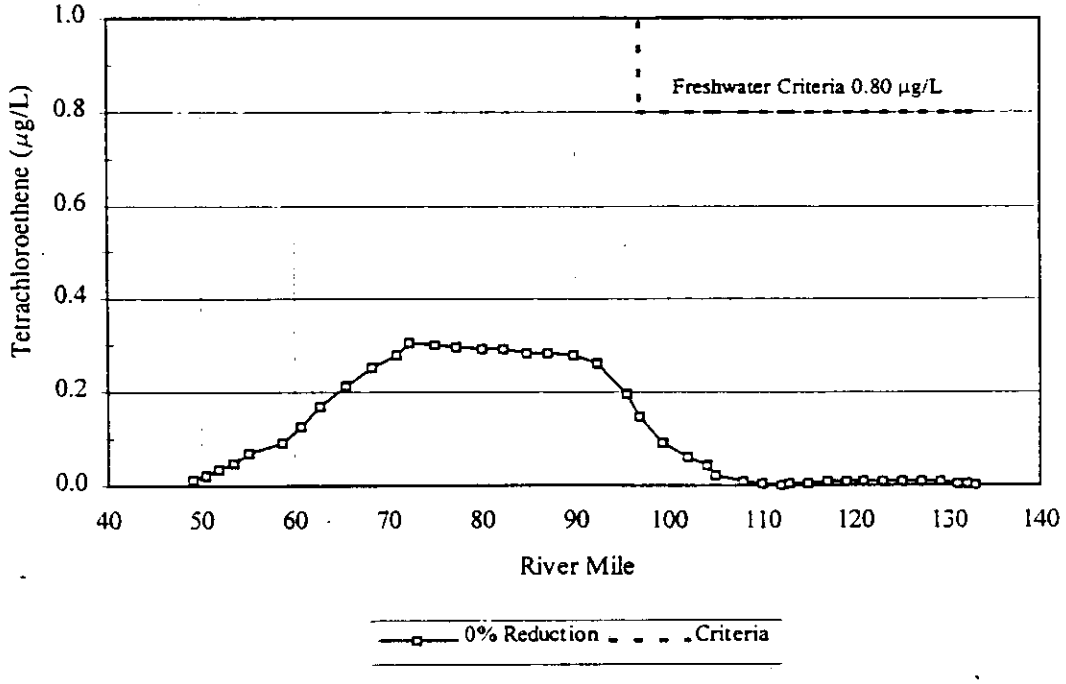


Figure 10 - Baseline Analysis for DuPont - Repauno

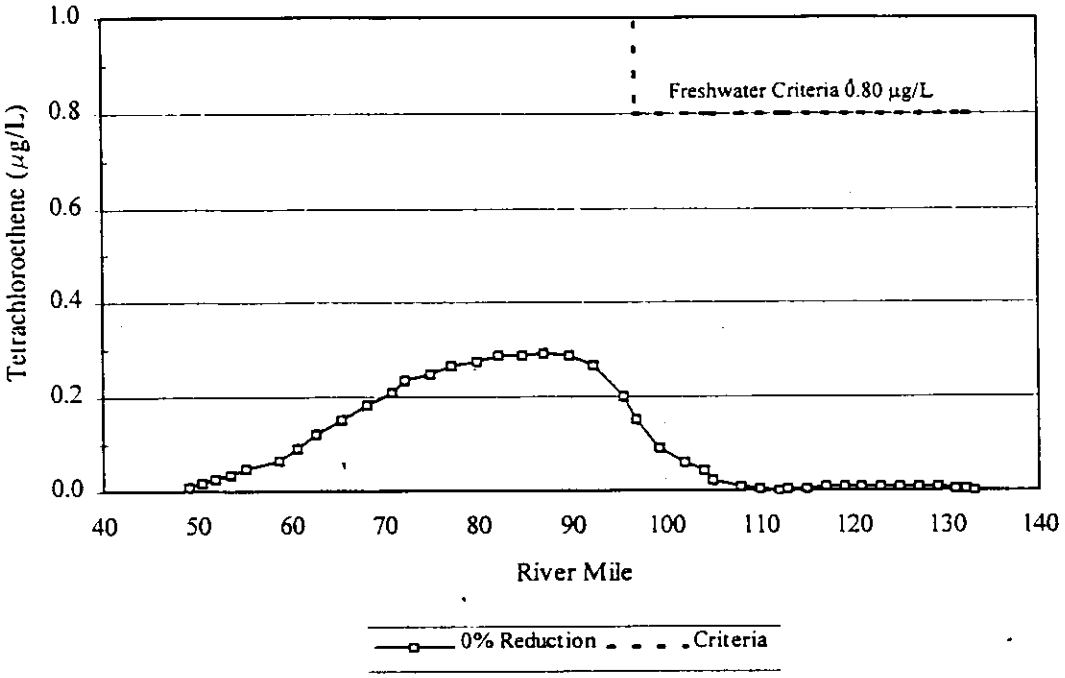


Figure 11 - Baseline Analysis for Philadelphia - SW

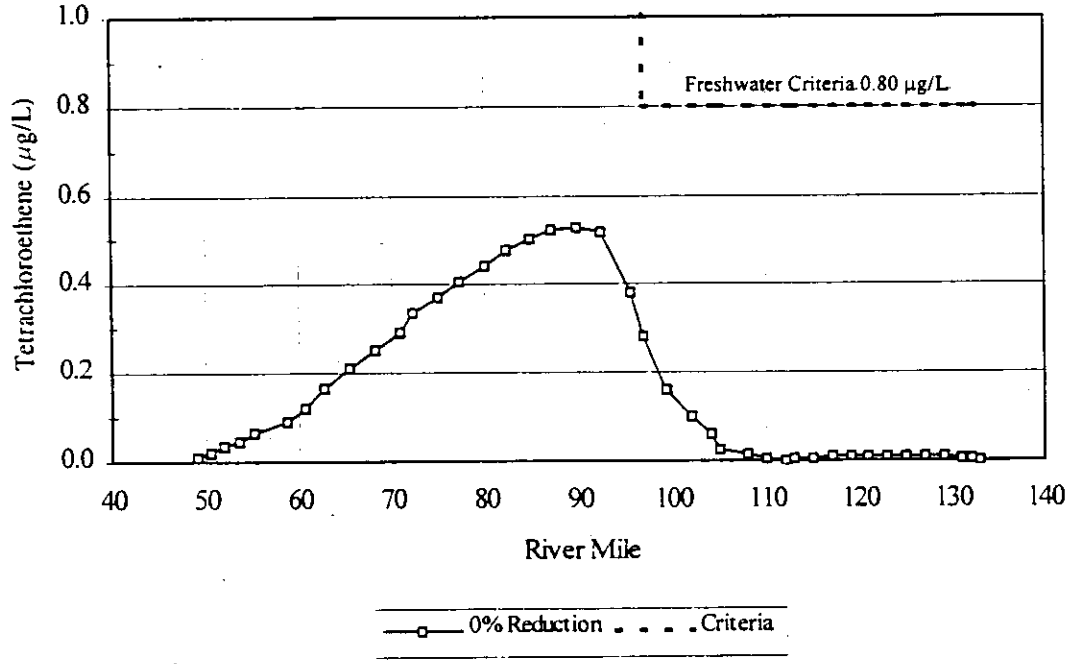


Figure 12 - Baseline Analysis for Philadelphia - NE

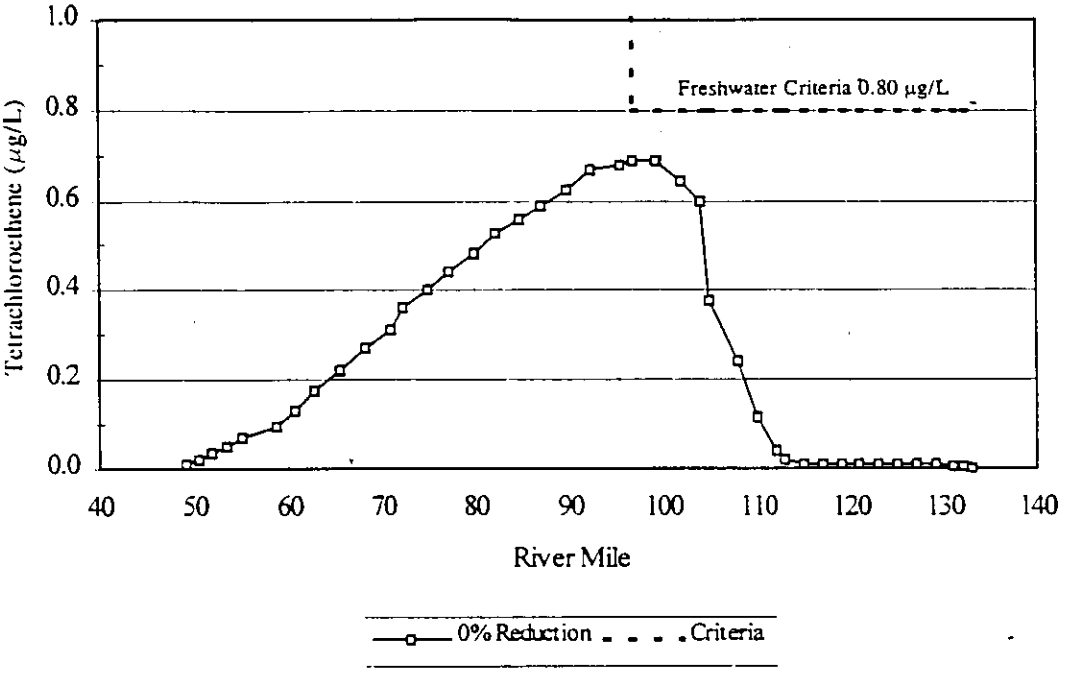


Figure 13 - Baseline Analysis for USX

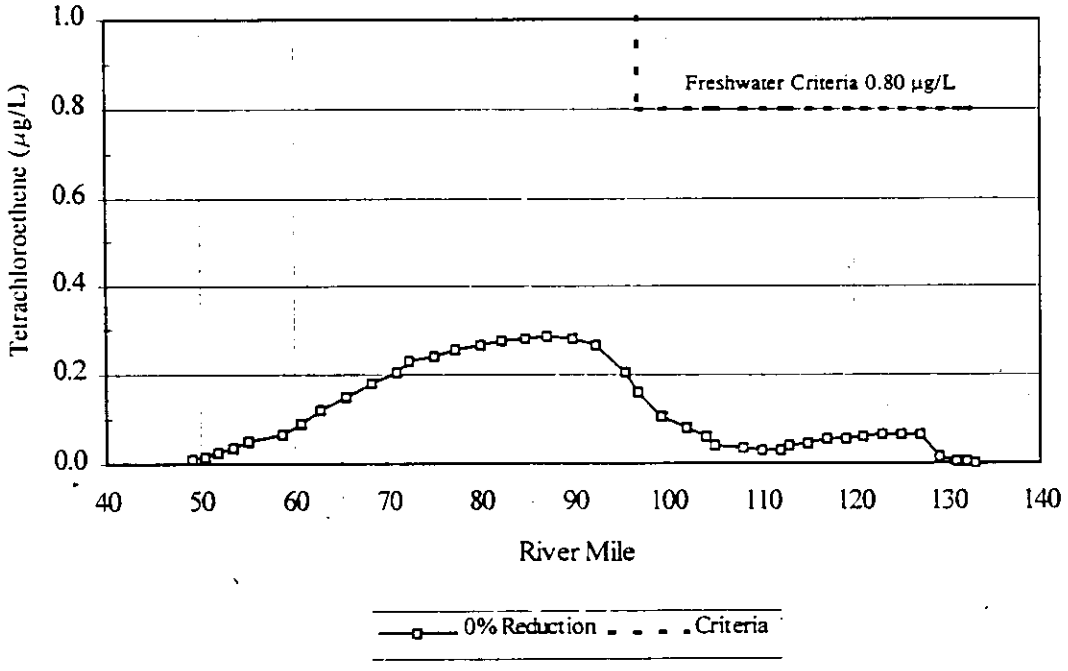


Figure 14 - Baseline Analysis for Hamilton Township

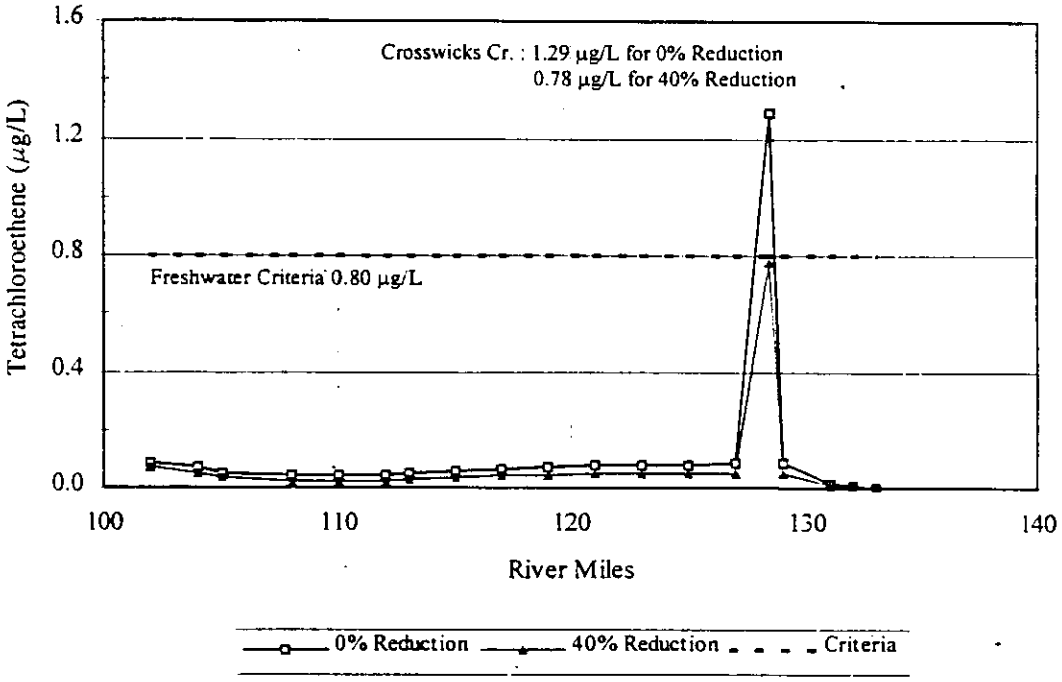


Figure 15 - Multiple Analysis - Reduction of Loading in Zone 5

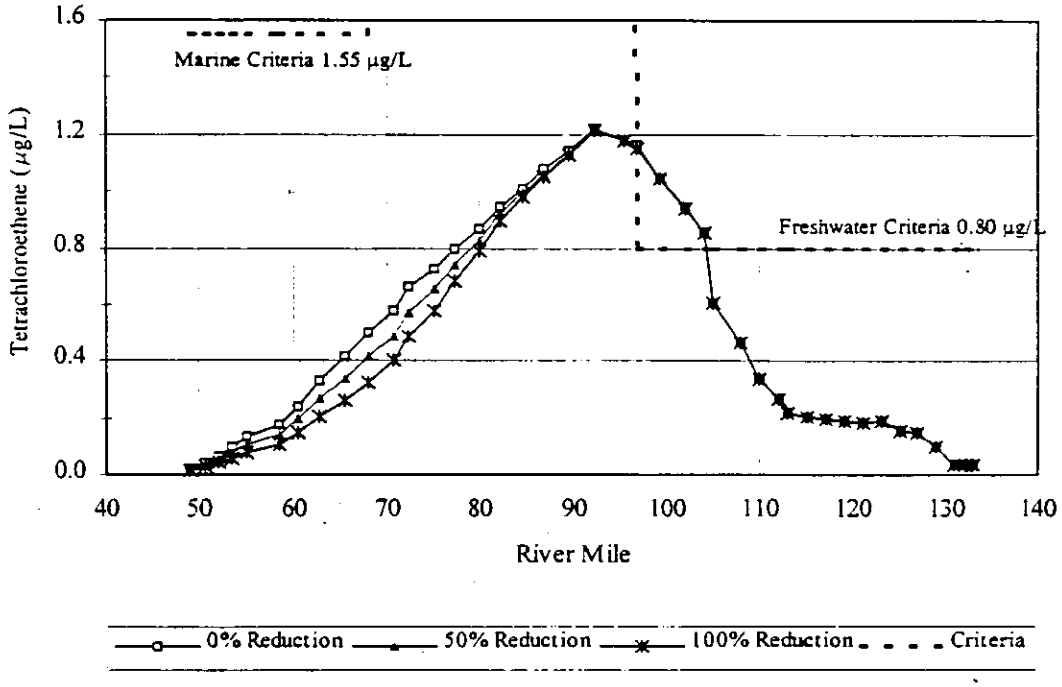


Figure 16 - Multiple Analysis - Reduction of Loading in Zone 4

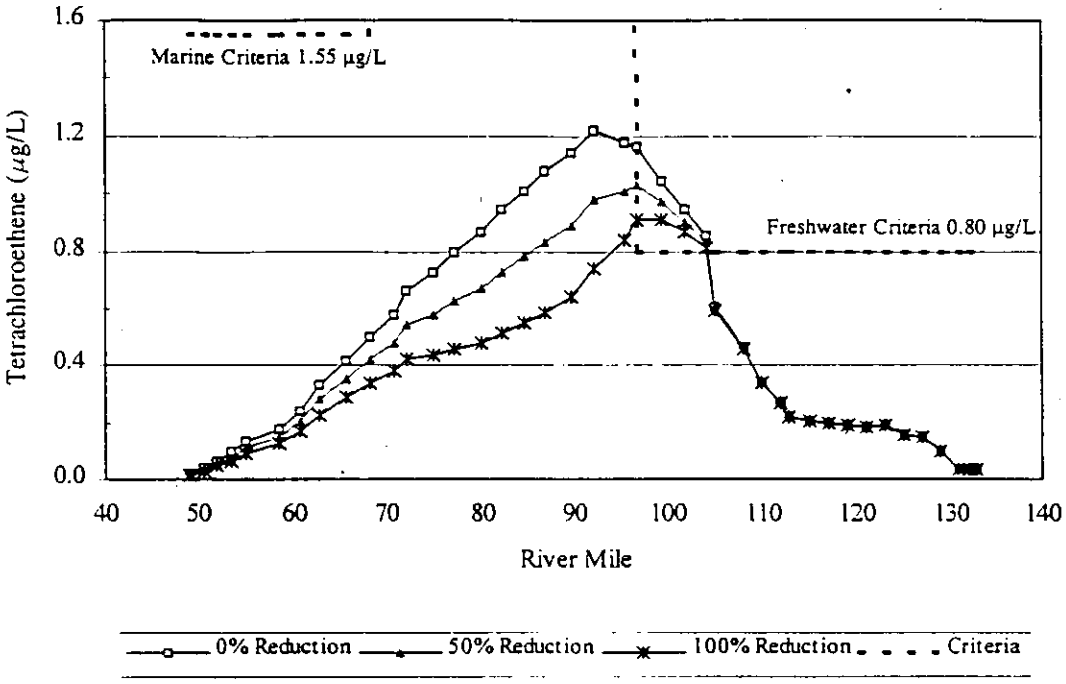


Figure 17 - Multiple Analysis - Reduction of Loading in Zone 2&3

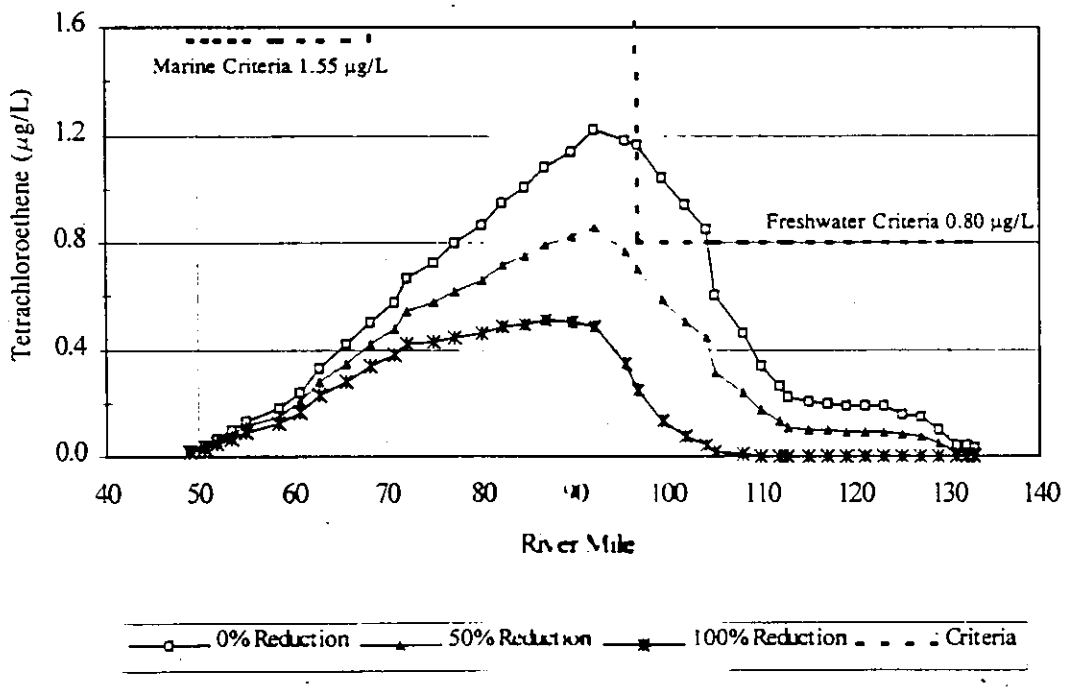


Figure 18 - Effect of Reduction of Baseline Load

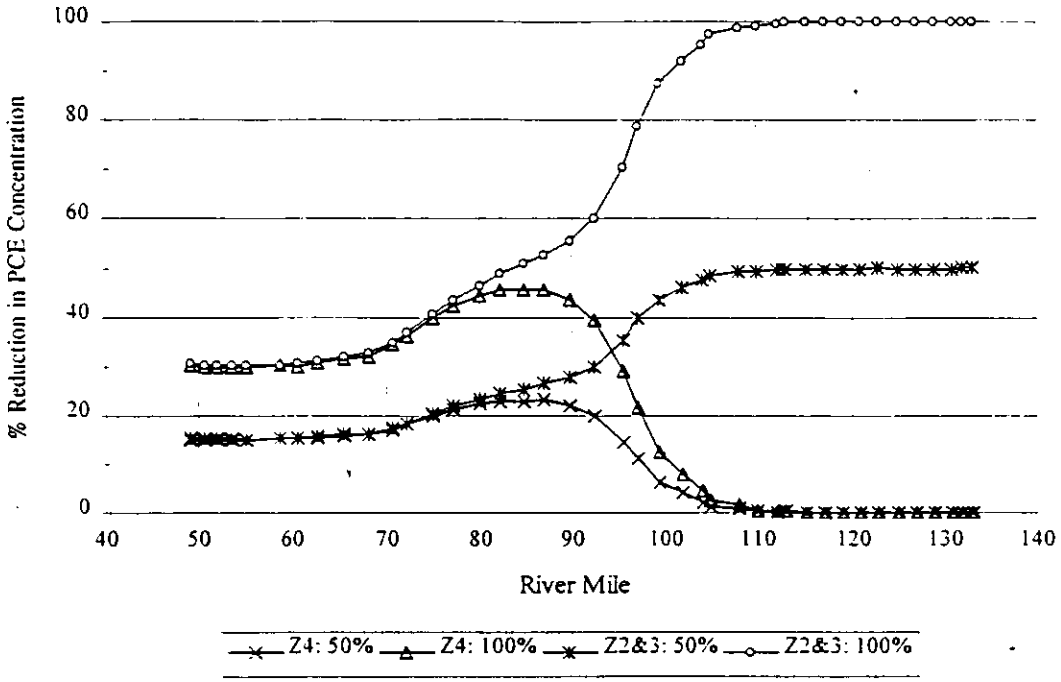


Figure 19 - Multiple Analysis for Tetrachloroethene